Section 4.0 Environmental Consequences

The resources discussed in this section were identified as the resources potentially affected by the Proposed Action, and include applicable "Critical Elements" of the human environment whose review is mandated by Executive Order, regulation or policy. Each of these resources has been reviewed for the Proposed Action and the No-Action Alternative. Some aspects of the affected environment (forestry, recreation, hazardous/solid wastes, prime/unique farmlands, and floodplains) are not present in the area or would not be affected by the Proposed Action, were not identified during scoping as a resource of concern, and therefore were not analyzed here.

The analysis includes direct, indirect, and cumulative impacts. Direct effects are caused by the action and occur at the same time and place. Indirect effects are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Cumulative effects are impacts that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). The cumulative impact analysis included the anticipated effect of the Proposed Action and the anticipated actions of other agencies as determined through a review of public documents, information gained from public meetings, and coordination with multiple agencies.

4.1 Air Resources

Fire management activities could affect air quality through smoke emissions from wildfires, prescribed burn, exhaust from machinery used in site preparation, fire control, monitoring, and thinning activities. Smoke from wildfires and prescribed fire is a complex mixture of carbon, tars, liquids, and gases. The major pollutants are particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide (CO), and volatile organic compounds (VOC). Nitrogen oxides (NOx) are also produced in relatively small quantity compared to the other pollutants. Sulfur oxides (SOx) compounds are produced in negligible quantities due to low elemental sulfur content of forest fuel. SOx, is not identified as a problem in prescribed burning and therefore not included in the analysis. The most effective method of controlling wildfire emissions is to prevent the occurrence of wildfires. Prescribed burning is one of the most frequently used techniques as a preventive measure for reducing wildfire occurrence. Although some air pollution is generated, the net amount of air pollution is a relatively smaller quantity than that produced by wildfires.

To quantify smoke emissions that would result from each of the alternatives in each of the planning areas, the First Order Fire Effect Model version 5 (FOFEM) was utilized. FOFEM is a computer-based planning tool that provides quantitative predictions for planning prescribed fire, for impact assessment, and for long-range planning and policy development. FOFEM is designed to provide quantitative fire effects information for tree mortality, fuel consumption, soil heating, and smoke. FOFEM was utilized to generate emission factors for PM_{10}, $PM_{2.5}$, CO, carbon dioxide ($C0_2$), and VOC (as CH_4). FOFEM does not provide emission factor for NOx. NOx factor was estimated using AP-42, EPA Compilation of Emission Factors. AP-42 estimates NOx emission factor from wildfires and prescribed fires to be approximately 35 times less than those for CO. Therefore, the CO emission factor generated by FOFEM was scaled down proportionally to produce NOx emission factor.

The vegetation zones defined within the planning areas based on the Ecological Aggregation of GAP Vegetation data set (**Table 3.4**) were correlated with the Society of American Foresters (SAF)/Society for Range Management cover types available within FOFEM. Defaults within FOFEM were used. In some cases, direct correlation between cover types was not possible, and a surrogate SAF/SRM cover type was selected. Some areas include bare rock or water for which no emissions are expected. The SAF/SRM and FOFEM cross-referenced vegetation cover types used in the air quality analysis are provided in **Table 4.1**.

The variations in vegetation cover types and associated fuel loads from one planning area to another and in some cases within one planning area warrant separate FOFEM runs for each area. The emission factors generated, using FOFEM along with appropriate fuel loading conditions for each vegetation type, are segregated by areas and provided in **Table 4.2**.

Table 4.1 – Vegetation Cover Types Used in Air Quality Emissions Analysis

GAP Vegetation Type	Plant Growth Form	SAF/SRM Type	Comments
Lower Sonoran Desert Scrub	Shrub-microphyllous	SRM 729, 506, 414, 211	FOFEM default used under typical condition
Upper Sonoran Desert Scrub	Shrub-microphyllous	SRM 507, 506	FOFEM default used under typical condition
Great Basin Conifer Woodland	Tree-conifer	SAF 238, 220 and SRM 412, 107	FOFEM default used under typical condition
Mojave Desert Scrub	Scrub-microphyllous	SRM 506, 501, 414, 211	FOFEM default used under typical condition
Great Basin Desert Scrub	Shrub	SRM 405, 401, 320, 314, 107	FOFEM default used under typical condition
Plains and Great Basin Grasslands	Grass	SRM 712, 709, 708, 705, 612, 611, 502, 310, 301	FOFEM default used under typical condition
Semidesert Grassland	Grass	SRM 707, 703, 505	FOFEM default used under typical condition
Interior Chaparral	Schrub-sclerophyll	SRM 503, 208, 207	FOFEM default used under typical condition
Chihauhuan Desert Scrub	Scrub-microphyllous	SAF 242, 068 and SRM 729, 211	FOFEM default used under typical condition
Riparian	Tree-cottonwood-willow	SRM 422	FOFEM default used under typical condition
Madrean Evergreen Woodland	Tree-mixed	SAF 241, and SRM 734, 733	FOFEM default used under typical condition
Petran Montane Conifer Forest	Tree-conifer	SAF 240, 237, 210, and SRM 110, 109	FOFEM default used under typical condition

Table 4.2 – Average Emission Factors

Planning Area (RMP/MFP)	Part of Planning Area	Emission Factor (ton/acre)				
		PM_{10}	$PM_{2.5}$	CH_4	CO	NOx[a]
Arizona Strip	Eastern half of area	0.135	0.114	0.064	1.327	0.038
	Western half of area	0.130	0.111	0.063	1.309	0.037
Phoenix	Northern half of area	0.135	0.114	0.064	1.327	0.038
	Southern half of area	0.138	0.117	0.065	1.339	0.038
Kingman	Northern half of area	0.031	0.027	0.016	0.330	0.009
	Southern half of area	0.026	0.022	0.007	0.078	0.002
Safford	Northern half of area	0.099	0.084	0.047	0.958	0.027
	Southern half of area	0.090	0.077	0.042	0.856	0.024
Lower Gila South	Entire area	0.013	0.011	0.005	0.063	0.002
Lower Gila North	Entire area	0.013	0.011	0.005	0.063	0.002
Yuma	Entire area	0.013	0.011	0.005	0.063	0.002

[a]Based on CO factor

4.1.1 No-Action Alternative

Under this alternative, air quality would be periodically impacted from large wildfires.

4.1.2 Proposed Action Alternative

Direct, Indirect, and Cumulative Impacts:

Under this alternative, short-term, minor adverse impacts to air quality with respect to PM_{10} and CO are anticipated. Minor increases in PM_{10} or CO concentrations would not be sufficient to cause any change in the NAAQS attainment status. Adverse impacts on visibility resulting from smoke emissions would be localized and only last for the duration of the burn since prescribed burns are likely to be conducted during optimal smoke dispersion periods. Adverse health impacts are not anticipated.

The proposed action in the long run improves air quality and visibility compared to the No-Action Alternative for the following two reasons. Prescribed fires produce less smoke emission than wildfires because they are normally conducted during optimal smoke dispersion periods, under less extreme conditions, and in forest environments fires primarily affect ground level fuel. Secondly, areas that have been treated with prescribed fires have reduced fuel loads. This decreases the potential for catastrophic wildfires that might occur in those areas resulting in a net reduction in smoke emission.

The adverse air quality impacts would be short-term. Cumulative effects of air emissions (PM_{10} and CO) and visibility problems from existing sources, such as stationary point sources, fireplace, road ducts, construction sites, agricultural activities, automobile, etc., in the areas or contiguous land across state line could have minor to moderate adverse impacts. The proposed action would bring about an improvement in air quality in the long-term due to reduction in fuel load and less fire fighting activities.

4.2 Soil Resources

Fire can have a wide range of impacts on soils because of the inherent variability of soils, vegetative cover, fire behavior, environmental conditions, and treatment method. These impacts can be evaluated most effectively on a site-specific basis. This section evaluates general impacts to soils from the No-Action and the Proposed Action Alternatives.

4.2.1 No-Action Alternative

Suppression of all wildfires in accordance with the current fire management plans would have no new impact on soils. Existing impacts in fire-affected areas include greater susceptibility to accelerated soil erosion and sedimentation due to fire suppression activities and the loss of vegetative cover. The severity of the erosion is dependent on soil texture, slope, vegetative cover return intervals, and the precipitation intensity after the soil is disturbed. At the same time, the absence of fire can lead to greater fuel loads that could increase the frequency and intensity of fires in the long-term. As the intensity of the fire increases, the severity and duration of impacts on soils also generally increases.

Fire affects the physical, chemical, and microbial properties of soil. Catastrophic, high intensity fires have the most severe and long-lasting negative impact on soils. Higher temperature fires occur where thick, dry litter layers accumulate, heating soils to a greater depth (up to 4 inches) and a higher surface temperature (approximately 750°F or higher) compared to lower intensity fires (less than 1 inch and 250°F or lower). Above ground vegetative cover and organic matter, and below ground root systems provide structure and stability for the soil. Intense fires remove organic matter and vegetative cover more completely and deeply, leaving soil more susceptible to large-scale, accelerated erosion.

Soil heating also reduces soil organic matter and can cause shifts in microbial populations that affect nutrient cycling. Organic matter helps regulate soil moisture, the carbon/nitrogen ratio, microbial populations, and maintains soil structure, porosity and cation exchange capacity. Although many soils on BLM administered land in Arizona are low in organic matter, even small amounts contribute to these important soil properties.

One of the more severe affects of fire on soils is the formation of water-repellent layers through heating of organic compounds. This phenomenon, known as hydrophobicity, most commonly occurs on dry, coarse textured (sandy) soils that support shrub vegetation communities, such as chaparral. Hydrophobicity is most severe in soils heated to intermediate temperature (approximately 350 to 550°F). The formation of water-repellent layers can dramatically increase soil erosion, directly by inhibiting moisture infiltration, and indirectly by inhibiting vegetative recovery. Higher intensity fires can also increase impermeability in the limited areas with soils containing higher clay content.

Fire suppression is preferred on BLM administered lands with soils supporting non-fire adapted vegetation (**Table 4.3**). These non-fire adapted areas are generally characterized by soils that are low in nutrients, organic matter and water holding capacity, and associated with arid or semi-arid environments. These characteristics would indicate slow fire return intervals, which would prolong the exposure of the soil surface to accelerated erosion from wind or precipitation. Soils on steeper slopes are especially vulnerable. Other fire-related activities that disturb the soil surface or vegetative cover, such as road and fireline construction, or mechanical fuel reduction, would also increase susceptibility of the soil to erosion.

4.2.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

Prescribed fires, and/or mechanical, chemical, or biological fuels reduction treatments would be considered on BLM administered lands with soils supporting fire adapted vegetation communities (**Table 4.4**). The direct impact of these actions would include effects on erosion, soil permeability and soil fertility.

Table 4.3 – Percentage Of Non-Fire Adapted Vegetation Supported On Soil Suborders On BLM Administered Land In Arizona

Non-fire adapted vegetation communities	Soils suborders					
	Orthids	Argids	Orthents	Ustolls	Fluvents	Ustalfs
Lower Sonoran Desertscrub (%)	35	20	19	0	3	0
Upper Sonoran Desertscrub (%)	28	28.5	44	2.0	6	11
Mojave Desertscrub (%)	8.5	15	4.5	0.4	4	0
Chihuahuan Desertscrub (%)	0.5	8.5	0.2	0.5	11	0
Total (%)	**72**	**72**	**67.7**	**2.9**	**24**	**11**

Table 4.4 – Percentage Of Fire Adapted Vegetation Supported On Soil Suborders On BLM Administered Land In Arizona

Fire adapted vegetation communities	Soils suborders					
	Orthids	Argids	Orthents	Ustolls	Fluvents	Ustalfs
Great Basin Woodland (%)	9.5	6.7	6.4	42.5	11.1	70.6
Great Basin Desertscrub(%)	11.6	4.6	4.9	2.5	13.3	7.0
Plains and Great Basin Grassland (%)	5.4	4.1	6.0	2.7	33.3	4.8
Semidesert Grassland (%)	0.3	7.9	3.7	32.9	3.8	2.1
Interior Chaparral (%)	0.1	2.8	8.8	11.9	0	4.1
Madrean Evergreen Woodland (%)	0	0.2	0.7	2.9	0	0.1
Montane Conifer Forest (%)	0	0.01	0.1	1.6	0	0.4
Riparian (%)[1]	0.9	1.2	2.1	0.1	7.1	0
Total (%)	**27.8**	**27.5**	**32.7**	**97.1**	**68.6**	**89.1**

[1] Riparian areas are not generally considered fire adapted, however prescribed fires may be necessary in some instances.

Prescribed fires and mechanical fuel reduction treatments would directly impact soil by increasing erosion rates due to fireline construction or road building, especially on steeper slopes. Heavy equipment could increase soil compaction, slowing the re-establishment of vegetative cover. Chemical fuel reduction treatments may leave residues that can alter soil microbial populations or vegetative recovery, affecting the productivity of the soil and increasing the vulnerability to erosion. Care should be taken to minimize soil disturbance, and chemical residuals, and preserve some vegetative cover and root systems to stabilize the soil and speed recovery. Over time, less mechanical and chemical fuels treatments would be needed to reduce fuel loads.

Prescribed fire can also impact soil properties and permeability as previously mentioned, especially if fires are allowed to reach higher temperatures. However, the frequency and intensity of the fires would decrease over time as fuel loads decrease, reducing some of the impacts on soil properties. Also, fuels can be removed by mechanical treatment prior to prescribed burns, or prescribed fires timed to coincide with higher moisture conditions, to produce lower temperature fires.

Soils in riparian areas are not generally considered fire-adapted, but tend to be less vulnerable to detrimental soil heating due to the inherently higher water content. However, vegetative buffer strips should be maintained along these sensitive riparian areas to decrease stream sedimentation. Furthermore, organic soil that becomes dry will burn deeper and at higher temperatures, destroying the organic reserves and soil structure. If prescribed burns in riparian areas are necessary, they should be conducted when the soil and vegetation reach higher moisture contents, which decrease the likelihood of excessive soil heating and are favorable for rapid recovery of vegetation. Mechanical or chemical fuel treatments are not generally considered feasible in riparian areas for logistical reasons and the close proximity to water.

Fire alters the microbial communities and nutrient cycling. Microbial populations can shift after fires or decline entirely for periods of time depending on the intensity of the fire. However, fire effects on soil microorganism communities are complex and not fully understood. Fire also effects nutrient cycling, primarily by increasing the pH in more acidic soils, which would affect nutrient availability to plants. However, arid and semi-arid soils, like those common in Arizona, are typically alkaline, and therefore pH is less likely to be affected (Clark, 2001). Fire does increase nitrogen available for plant growth by converting nitrogen previously bound in unavailable forms, such as organic matter or woody material, into ash and a more plant available form of nitrogen (ammonium). However total nitrogen decreases from losses due to erosion or volatilization. Over time, nutrient deficiencies, particularly nitrogen, may result (Caldwell et.al., 2002; Macadam, 1989). Sulfur and phosphorous are also more readily lost, but to a lesser extent. Information is conflicting on the impact of these changes in nutrient availability, and the degree of long-term nitrogen loss is largely dependent on the intensity and frequency of the fire.

The occurrence of catastrophic wildfires should decrease over time as fuel loads decline. Reducing severe wildfires can protect soils from long-term damage and degradation of the soil properties, fertility and structure. Improving the long-term stability of the soils also improves the viability of the native fire-adapted vegetative communities the soil supports. Fire-adapted areas are less likely to be affected by repeated cycles of nutrient losses, and frequent, low-temperature fires have fewer, and shorter-lived effects on soils (McNabb, et al., 1990). Additionally, recent studies have shown erosion and sedimentation is up to 10 times lower following prescribed fires compared to high intensity wildfires (Wohlegmuth et.al. 1999).

4.2.3 Mitigation Measures

Soil management considerations for prescribed fire.

Erosion

- Accelerated post-fire erosion is most dependent on slope steepness and the vegetative recovery interval.
- Preserve some coarse, woody material, vegetative root systems, organic matter and duff to help protect against soil erosion.
- Minimize impacts of firelines and road construction by rehabilitating through replacement of soil or plant material as soon as possible.

Soil Heating

- Minimize soil heating whenever possible by removal of excess or piled duff.
- Conduct prescribed burns while moisture content of fuels and soils is higher, limit the duration of the fire and penetration of the heat into the soil.

Riparian Areas

- Leave buffer zones along riparian areas to stabilize soils and decrease stream sedimentation.

- Use prescribed burns in riparian areas only when necessary and during higher soil and vegetative moisture conditions to minimize soil heating and organic matter loss, and speed vegetative recovery.

4.3 Water Resources

This section describes potential consequences of fire on water resources and identifies the likely effects of fire management alternatives on water resources on BLM lands in Arizona. Potential effects of fire were considered in terms of effects on surface water quantity and quality and on groundwater resources. The effects of fire on water resources are largely indirect and delayed in time; when fires burn to surface waters, there can be substantial deposition of ash to the water, heating of the water, and loss of cover. More significant effects, however, typically result from water flow and erosion that occur with rainstorms and snowmelt that might not occur until many months after the fire.

4.3.1 No-Action Alternative

Under the No-Action Alternative, increased fire frequency, size and severity would have extensive effects on water quality. As the area burned by fires increased, the effects would be reflected in an increase in the number of stream reaches in which water quality is affected, and by more severe degradation of waters within some stream systems (i.e., as the proportion of burned area increases in a given watershed). The overall extent of disturbance can be expected to increase at least in proportion to increases in the area burned; to the extent that fires burn hotter, with greater damage to soils, relative aggregate disturbance would be even greater. The extent of actual effects cannot be quantified, because the extent of damage depends, as noted above, on the area burned, severity of fire, slope, and erodability of soils in the burned area, and with the amount and intensity of subsequent rainfall in the area.

Most of the important effects of fire on water quantity and quality ultimately result from destruction of vegetation and soil litter by fire. Destruction of vegetation and litter can affect water in several ways, including decreased soil stability, leading to increased erosion of upland soils during rainstorms or snowmelt, and to loss of bank stability along streams. The ultimate effect is increased loadings of solutes, suspended solids and bedload to surface waters, adversely affecting water quality and aquatic flora and fauna. The suspended solids are eventually deposited, either within the stream channel, near the stream mouth in standing waters, or in adjacent bank and wetland/riparian areas. Loss of vegetation can also result in a temporary decrease in the infiltration capacity of soils, causing increased surface runoff and exacerbating erosion until the vegetation has been re-established in a burned area.

In riparian areas, fire can have several consequences that result from loss of vegetation and soil litter, including loss of shading (leading to elevated water temperature), decreased retention of nutrients and toxins by vegetation and soil microfauna, and decreased retention of particulates from surface runoff across the riparian buffer. Fire suppression can also affect water resources; soils and vegetation in riparian areas by being disturbed or damaged by heavy equipment traffic, and components of foams and aerial retardants can be toxic to aquatic fauna if released into or near surface waters.

The aggregate effect of these processes is primarily as changes to water quality – minor to very significant increases in suspended solids, and some times increases in temperature, nutrient and metal concentrations. The degree and duration of change are influenced by several factors, including size and severity of the fire, proximity of the burned area to surface waters, slope, erodability of soils, and amount and intensity of precipitation. Changes to conditions in the water column are temporary, and would wane as vegetation is re-established and erosion is controlled, but deposition of sediments can lead to long-term changes in stream morphology and habitat.

4.3.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

Under the Proposed Action, fire and fuels would be managed in ways intended to create a more natural role for fire within ecosystems. Water resources have not been a major factor in planning fire and fuel management, except for management of streamside and riparian areas. As a critical element of the desired future conditions articulated for BLM-administered lands, nearly all waterways, creeks, and riparian areas would be managed as Category “A” lands where fire is not desired at all. Under this approach, these areas would be subject to full suppression of all unplanned fires to protect endangered species and to maintain the values and condition of these systems. Fire suppression tactics in riparian areas would largely exclude use of heavy equipment to avoid disturbance and damage to the area, and would include restrictions on the use of foam and aerial retardants except as a “last resort” to avoid total loss of habitat. Use of prescribed burns would be limited to areas where they would favor protection or regeneration of

native species (and suppression of exotic species), such an approach has been proposed along the San Pedro River and Cienega Creek as a tool to reduce fuels and reduce potential mortality of cottonwood/willow gallery forest that would occur with high-intensity fire. Conversely, mechanical treatment has been proposed for riparian areas in the Yuma/Lake Havasu management zone to create fire breaks between fire intolerant (native) and tolerant (exotic) species, in an area where fire would favor the invasive species.

As vegetation conditions move toward desired conditions over a period of several years, fuel loads would decrease in many areas. As this occurs, it is expected that there would be a decrease in the occurrence of catastrophic fires, with fewer large, intense fires. Part of the decrease would be offset by increasing the area and frequency of prescribed burns, but these would be planned and implemented as smaller, cooler fires, with correspondingly less impact to vegetation and soil, in turn reducing the potential extent of erosion and degradation of water quality.

In considering environmental consequences of management decisions related to fire and fuel management, it is unlikely that management decisions would cause any substantive or long-term changes in the occurrence of surface water resources. Disturbance by fire, mechanical removal of vegetation, changes in plant species, etc., have the potential to cause at least transient changes in water quality, particularly for suspended solids and nutrients, as discussed in Section 3.1.3.3.

As desired conditions are attained, direct effects of fire on water quality would be expected to decrease, for two reasons. First, the frequency of fires burning into, and through, streamside and riparian areas can be expected to decrease as a consequence of the overall decrease in the number of large, catastrophic fires. In addition, as suppression policies change and vegetation conditions improve, fire management resources would be focused on suppression of fires in Category A areas (including streamside and riparian areas), further decreasing the extent of fire in these fragile areas, and proportionally reducing direct effects from ash deposition, loss of cover, streambank failure, etc. Effects on groundwater resources are expected to be negligible.

As desired conditions are attained, the occurrence and degree of water quality degradation resulting from indirect effects of fire (primarily erosion), can also be expected to decrease. By replacing large, hot fires with smaller, cooler fires, survival of desirable vegetation would increase, and damage to the soil would decrease. Decreases in the extent and duration of erosion should follow, reducing the number and length of stream reaches affected. More importantly, by decreasing the severity of fire and managing the size and location of fire, the severity of erosion and extent of water quality degradation within an affected watershed would be expected to decrease. Recent analyses by the Forest Service (USFS 2003) suggest that use of thinning and prescribed fire could reduce sediment yields in western ecosystems by a factor of 30 to 70 compared to losses following wildfire. To insure that water quality considerations are included in planning for fire management, including planning of prescribed burns, it would be desirable to adjust land categories to minimize effects of fire on water quality for areas where: potential for soil erosion is high due to slope and/or erodability of soils (Section 4.2); water quality is known to be impaired (e.g., 303(d) or planning listed waters); or where waters have been identified by the Arizona Department of Environmental Quality as “unique waters” because of their “exceptional recreational or ecological significance” or because they provide critical habitat for endangered species.

Effects of fire on water quality are generally of short duration, lasting only until vegetation is re-established on a burned area. As such, cumulative effects of fire on water quality are best considered in terms of the area affected, and by the degree of water quality degradation, rather than in terms of long-term temporal changes to a water body. As described in Section 4.3.2, implementation of the Proposed Action would be expected, as fuels and fire management evolve over several years, to decrease both the extent and severity of water quality degradation attributable to direct and to indirect affects of fire. Under the National Fire Plan, all federal land managers are mandated to reduce occurrence of catastrophic fires through changes to fire and fuels management. As programs are implemented on other federal and tribal lands, the occurrence of catastrophic fires in Arizona should decrease, and cumulative extent and severity of water quality degradation should likewise decrease.

4.4 Vegetation Resources

The purpose of this section is to identify the likely vegetation resource outcomes associated with the BLM management alternatives. Direct, indirect, and cumulative impacts to vegetation are discussed generally; the actual impacts would vary among the 12 vegetation communities. The following address a useful comparison of the scope and type of effects

that are expected under the No-Action and the Proposed Action Alternative.

4.4.1 No-Action Alternative

The No-Action Alternative would result in no new impacts to the 12 vegetation communities. All wildfires—regardless of ignition source—would be suppressed in accordance with current LUPs and fire management plans. The primary impact would the continuation of periodic wildfires, including large catastrophic wildfires (Brown 2000). It is anticipated that the number and acres burned will increase in future years following the trend in past years as shown in **Table 4.5**. Under the No-Action Alternative, hazardous fuels will continue to accumulate in the vegetation communities at rates respective to past years. The accumulation of hazardous fuels is a continuing concern especially in the WUI. The WUI will probably increase in importance as people continue to build houses near forests and rangelands.

Continuation of the current policies would lead to changes in the composition and structure of vegetation communities that eventually would lead to a loss of native plant diversity (Brown 2000). Fire dependant plant communities would continue to change as a result of continued fire suppression. Ecological conditions for vegetation would continue unchanged from the current state; however, this current state is quite different from the conditions under which these communities evolved.

Under the No-Action Alternative, it can be expected that ponderosa pine and pinyon-juniper forests would trend towards over-dense conditions, leading to forest health problems associated with insects, disease, drought, and fire. Grasslands would continue to be encroached upon by woody species such as sagebrush and juniper. Interior chaparral would continue to be encroached upon by forest/woodlands species at higher elevations. Exotic weeds would continue to increase in all vegetation communities.

4.4.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

The landscape under the Proposed Action would be divided into four fire management categories regardless of vegetation community. The fire management categories would be defined based on wildfire threat to human life and property, and historic fire return intervals. Hazardous fuel reduction would be vigorously pursued to reduce the risk of wildfire in the WUI and improve rangeland and forest health. The degree of fire suppression varies among the four categories. **Table 4.6** documents the hazardous fuel reduction projects under the no-change scenario (years 1990-2003) in comparison with the Proposed Action (year 2004).

Table 4.5 – Comparison Between the Number and Burned Acres of Human-Caused and Lightening-Caused Fire on BLM Lands in Arizona

Year	Human Caused Fires		Lightening Caused Fires	
	Number	Acres Burned	Number	Acres Burned
1983-1987	73	3,453	67	8,429
1988-1992	87	3,160	91	3,747
1993-1997	104	7,228	147	23,969
1998-2000	475	111,299	229	37,054

Table 4.6 – Types of Fuels Reduction Treatments on BLM Lands in Arizona Since 1990

Year	Fuel Reduction Treatment			
	Prescribed Fire	Mechanical	Biological	Chemical
	Acres	Acres	Acres	Acres
1990-1994	600	0	0	0
1995-1999	21,060	18	0	8,382
2000-2002	16,532	128	0	9,560
2003	8,256	272	0	2,000
2004[1]	9,931	10,277	0	2,000

[1] Proposed fuel treatment projects for year 2004. The implementation of future fuels treatment projects is contingent on several factors including funding, NEPA compliance, environmental conditions, and priority.

Under the Proposed Action, it is assumed that the Desired Future Conditions would be achieved over the next several years. As the Desired Future Conditions are achieved there would be fewer impacts to vegetation communities from catastrophic wildfire losses. The need for emergency post-fire rehabilitation to control soil erosion, the loss of wildlife habitat and livestock grazing land, and other effects would lessen. The continuing trend of building houses in the WUI is expected but with the reduction of hazardous fuels the risk of wildfire loss should lessen.

The Proposed Action would have a direct impact on existing vegetation communities in that hazardous fuel reduction would occur to lessen the probability of catastrophic wildfire from occurring (Paysen et al. 2000). Over the long-term, the Proposed Action would reduce hazardous fuels using management tools such as prescribed fire, mechanical, biological (including livestock grazing), and chemical treatments. Vegetation communities should return to their historic range of variability with regards to fuel load and type. Also, the natural occurrence of fuels and the historic fire regime reflective of a vegetation community should occur.

The direct effect on vegetation from hazardous fuels reduction by prescribed fire, mechanical, biological, and chemical tools would be primarily short-term and temporary and would be in the form of soil erosion, inadvertent damage to habitat, and damage to desirable plants. However, vegetation is resilient and recovery should be short term. Fuels reduction treatments would need to be re-administered every few years to maintain the normal range of variability. The management of natural occurring wildfire would remove unwanted hazardous fuels and improve wildlife habitat. The implementation of prescribed fire, mechanical, biological, and chemical treatments each pose direct negative impacts to vegetation communities such as soil erosion and damage to desirable plants. The removal of diseased, invasive, and overstocked plants would encourage the growth of healthy forest and rangeland vegetation. Under certain conditions, the re-seeding of desirable plant species may be necessary to inhibit weed establishment in areas where fuel reduction treatments have been implemented.

Impacts to vegetation from the Proposed Action are inherently direct, so there would be few indirect impacts. The ability of weeds to become established would decrease as desirable plant competition for space, light, nutrients, and water increases. As a result of prescribed fires, animals that are able would emigrate to adjoining suitable habitat, which could cause short-term (one year) impacts to vegetation habitats from this shift in population.

Vegetation communities in Arizona and throughout the United States have been impacted by the introduction of invasive species or noxious weeds (Howey and Ruyle 2002).. The ability of noxious weeds to become established and dominate would be reduced under the Proposed Action.

4.5 Fire Ecology

This section identifies the likely changes in fire ecology associated with the BLM management alternatives. Fire ecology of a vegetation community refers to fire behavior, return interval, and fuel load. Fire ecology is inseparable from the type of vegetation community. Therefore, changes to the character of a vegetation community will also affect its fire ecology.

4.5.1 No-Action Alternative

Under the No-Action Alternative, wildfire and vegetation community management would occur as in past years with a fire suppression policy and the continued accumulation of hazardous fuels. The fire suppression policy of past years has allowed high accumulation of hazard fuels, insect and mistletoe damage to woody plants, and weeds to increase dominance, which all contribute to unnatural, catastrophic wildfire (Howey and Ruyle 2002). **Table 4.5** illustrates the increasing trend in the number of fires and acres burned during the years 1983–2000. Continuation of this management approach would result in alterations to the natural fire regime (preventing fire from being a natural disturbance with a predicable return frequency), increased fuel loads outside the normal range of variability, and catastrophic wildfires because of the abnormally high accumulation of fuel. Fire would not be used to control the accumulation of fuel and help maintain normal vegetation composition, structure, and productivity characteristic of the vegetation community. Under the No-Action Alternative, fire would not be consistently managed by BLM across Arizona.

4.5.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

Historically, fire was a natural component of many forest and rangeland ecosystems in Arizona (Swetman and Baisan 1994). To mange fire as a natural component of ecosystems and achieve the

Desired Future Conditions, the landscape under the Proposed Action would be divided into four fire management categories regardless of vegetation community. The fire management categories would be defined based on wildfire threat to human life and property, and historic fire return intervals. Hazardous fuel reduction would be pursued to reduce the risk of wildfire in the WUI and improve rangeland and forest health. The immediate direct affect of the Proposed Action is the reduction of hazardous fuels.

The Proposed Action would have a direct impact on existing fire ecology in that hazardous fuel reduction would occur to lessen the occurrence of catastrophic wildfire (Brown 2000). Over the long-term, the Proposed Action would reduce hazardous fuels using management tools such as prescribed fire, mechanical, biological (including livestock grazing), and chemical treatments. The natural occurrence of fuels and the historic fire regime reflective of a vegetation community should occur.

The direct effect on fire ecology from hazardous fuels reduction by prescribed fire, mechanical, biological, and chemical tools would be long term and would encourage normal fire behavior and return intervals. Fuels reduction treatments would need to be re-administered every few years to maintain its normal range of variability. The management of natural occurring wildfire would remove unwanted hazardous fuels, improve wildlife habitat, and increase the health and vigor of vegetation (Brown 2000). The implementation of prescribed fire, mechanical, biological, and chemical treatments would each directly impact vegetation communities through soil erosion, damage to desirable plants and wildlife habitat. However, because vegetation is resilient these effects would be short term. The removal of diseased, invasive, and densely-growing vegetation would encourage the growth of healthy forest and rangeland vegetation. Under certain conditions, the re-seeding of desirable plant species may be necessary to inhibit weed establishment in areas where fuel reduction treatments have been implemented.

Impacts to vegetation and fire ecology from the Proposed Action are inherently direct, no other indirect impacts to fire ecology were identified.

The National Fire Plan applies to the U.S, Forest Service, National Park Service, U.S. Fish and Wildlife Service, the Bureau of Indian Affairs, as well as the BLM. All of these agencies administer federal land in Arizona and have fire management responsibilities. These agencies are mandated to take the necessary measures to reduce the occurrence of catastrophic wildfire through the reduction of hazardous fuels and improvements in forest and rangeland health. As these agencies seek to return vegetation communities to their normal composition, structure, and productivity, there should be an overall improvement in forest and rangeland health and wildlife habitat throughout the state. The overall occurrence and acres burned from catastrophic wildfire should decrease. State and local agencies, and Private land owners may become involved in this effort through partnerships with federal agencies.

4.6 Invasive or Noxious Weeds

4.6.1 No-Action Alternative

The No-Action Alternative represents continuation of current invasive or noxious weed management. No new impacts would occur under this alternative. The primary impacts from continuing the current fire management practices are periodic catastrophic wildfire which may contribute to the continued spread of invasive and noxious weeds (McAuliffe 1995, Brooks and Pyke 2002). Fire leaves various-sized parcels of land denuded of vegetation. This situation is conducive for the rapid colonization and establishment of invasive or noxious weeds. Each catastrophic fire and suppression effort opens up the burned area to infestation of invasive or noxious weeds. The re-occurrence of a fire shortly after a previous fire usually exasperates weed infestation. Furthermore, continued development of new houses in the WUI also creates disturbed areas where weeds or invasive species can become easily established which would contribute to increased fire hazard. The ability of many weeds to rapidly colonize recently disturbed areas results from the production of numerous seeds capable of wide dissemination and germination under various environmental conditions. Weed seedlings are able to grow rapidly and out-compete desirable plants for water, nutrients, light, and space. Once weeds are established, it is difficult for desirable vegetation to displace them without management intervention. Many weeds contribute to hazardous fuel loads because the senesced leaves and stems are highly flammable (Brooks 2002). When wildfires take place on sites where weeds are an important part of the plant mix, they usually burn hotter and faster than those with fuels derived solely from native vegetation, and as such, they can pose an increased risk to human life and ecosystem processes. Once the weeds are sufficiently abundant the likelihood of fire increases with the fire return interval becoming less.

4.6.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

Under the Proposed Action, the Desired Future Condition should be achieved over a period of several years. As the Desired Future Condition is achieved, weed invasion into new areas in response to catastrophic fire should decrease. Weed control would be vigorously pursued to reduce the risk of wildfire in the WUI and improve rangeland and forest health. The immediate direct affect of the Proposed Action is the reduction of hazardous, highly flammable fuels. Over the long-term, the Proposed Action would reduce and replace weed populations with desirable, less flammable native vegetation.

Hazardous fuel reduction projects targeted at weeds such as buffalograss or cheatgrass may reduce total infested acreage. Invasive or noxious weed control to reduce fire hazard can occur by a variety of ways including chemical, prescribed fire, biological, and mechanical or a combination of techniques (Howey and Ruyle 2002). After any weed control treatment is administered it is essential to deter the re-establishment of weeds. Encouraging the growth and productivity of desirable vegetation would most likely inhibit the re-establishment of the invasive weeds. The degree and type of rehabilitation management would depend of the nature and severity of the weed control treatment. Changes in grazing practices may be all that is needed on rangelands where minimal weed control has been implemented. However, rangelands where wildfire or prescribed burns have occurred would need aggressive rehabilitation practices to reduce the chances of weed domination before desirable plants can become established. Implementation may include soil erosion control and the seeding of desirable native and non-native perennial grasses and perhaps shrubs and forbs. Appropriate seed mixtures of native and non-native plants seeded at appropriate times are effective in becoming quickly established and not allowing weed seedlings to take root and would also minimize soil erosion.

The desired improvement to vegetation communities and the WUI from the Proposed Action would not occur immediately but may require 10–15 years to achieve. Vegetation communities should return to their normal composition, structure and productivity which, in turn, would affect the nature and severity of fires. Prior to European settlement, fire was a common and widespread ecological disturbance in Arizona (Swetman and Basian 1994). The fragmentation of ecosystems and reduction of fuels caused by grazing and cultivation that came with European settlement, along with fire suppression, caused a drastic decrease in fire occurrence and size in comparison with the historic natural range of variability. Significant changes in plant composition, structure and productivity that have occurred on some sites would unlikely have occurred in the pre-European settlement environment. Over the long term, vegetation communities should return to their natural composition, structure, and productivity resulting in improved health and vigor with the return of a natural fire regime. Wildlife habitat quality and diversity would increase with improved vegetation community health. The ability of invasive species to become established would decrease as desirable plant competition for space, light, nutrients, and water increases. The occurrence of catastrophic wildfire would decrease as vegetation communities achieve their normal composition, structure, and productivity.

The National Fire Plan applies to the U.S. Forest Service, National Park Service, U.S. Fish and Wildlife Service, the Bureau of Indian Affairs, as well as the BLM. All of these agencies administer federal land in Arizona and have fire management and weed control responsibilities. These agencies are mandated to take the necessary measures to reduce the occurrence of catastrophic wildfire through the reduction of hazardous fuels including weeds and to improve forest and rangeland health. As these agencies seek to return vegetation communities to their normal composition, structure, and productivity through weed control practices, there should be an overall improvement in forest and rangeland health and wildlife habitat. The overall occurrence and acres burned from catastrophic wildfire should decrease. State and local agencies and private land owners may become involved through partnerships with federal agencies.

4.7 Wild Free-Roaming Horses and Burros

4.7.1 No-Action Alternative

Information on the effects of wildland fire on WHBs and the animal's response to fire is limited. Information is available on some large mammals that share habitat with Wild Free-Roaming Horses and Burros (WHBs). For example, WHBs share habitat with desert bighorn sheep, desert mule deer, coyotes, fox and jackrabbits.

The primary impacts to WHBs from continuing the current fire management practices are from large, catastrophic wildfires. Wildland fires generally kill or injure a relatively small proportion of large

mammal populations, although large, intense, stand-clearing fires are dangerous to animals caught in its path. In large wildfires, large mammals must find a safe location in unburned patches or outside the burn. Large mammal mortality would be most likely from fires with wide and fast moving fronts, that are actively crowning, and that have thick ground smoke occurs (USFS, 2000).

Large wildfires would indirectly affect WHBs through the loss of habitat and the reduction of forage and available cover. Wildland fires would force WHBs to travel long distances out of fire areas to find food and water. Because large mammals depend on vegetation for forage, bedding, cover, and thermal protection, they would abandon burned areas if fire removes many of the habitat features they need. Thus, catastrophic fires and understory burns that are severe enough to top-kill shrubs and young trees would likely trigger higher rates of emigration than patchy or low-severity fires. Impact would be greatest to mares with foals. The season of burn could also be an important factor in mortality. During winter months, many WHBs would be stressed by being on unfamiliar rangeland which has little available forage and water. Herd areas would be disrupted and movement patterns could also be interrupted by large-scale fire rehabilitation efforts. As a result of large wildland fires, WHBs could be moved under an emergency gather, or WHBs could also seek forage on other HMAs, leading to overuse of that vegetation.

4.7.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

Under the Proposed Action, there would be few direct impacts to WHBs from chemical, mechanical, or biological treatment methods. WHBs would be expected to avoid human contact associated with treatment activities. Prescribed fires and natural-start fires would impact WHBs through the temporary loss of habitat and the reduction of forage and available cover. Small, patchy or low-severity fires associated with prescribed fire would have less impact than large, catastrophic fires. Prescribed fire would not be large enough to force WHBs onto unfamiliar rangeland.

Most of the literature regarding the relationship between fire and large mammals focuses on fire-caused changes in vegetation and how habitat changes influence animal populations. As discussed in Section 4.4.2, burning often increases and improves forage, the biomass of forage, and sometimes the nutritional content and digestibility of plants Prescribed burns would improve WHB habitat by diversifying the plant community and increasing the percentage of perennial grass and desirable shrub ground cover. Because ungulates are sensitive to alterations in vegetation structure, however, their net response to fire depends on its severity and uniformity (USFS, 2000).

The Proposed Action would result in temporary reduction in available forage for WHBs. Large scale, intensive fire in contiguous stands of grass and shrub communities would affect WHBs by decreasing availability of forage and cover. The impact would be greater if the treated area is favored for forage, foaling, or cover. This should extend the period of time WHBs can use any given area. Fire can also negatively affect habitat when range condition is poor and forage species cannot recover, when nonsprouting species that provide forage are eliminated, or when too much areas is burned and forage is inadequate in the home range until the next growing season.

To mitigate potential impacts to WHBs, naturally-ignited fires and prescribed fires should not be allowed to burn extensive, contiguous areas of any one HMA in the same year. Because horses are terrified of fire and will run wildly, when horses are present in the area, prescribed fires set in close proximity to fences should be started in such a way to decrease the likelihood of horses running through the fence. Burning should also be limited during the peak foaling period from March 1 through June 30.

In addition to the BLM, other Federal agencies that manage lands in Arizona are expected to undertake actions to reduce the occurrence of catastrophic wildfire through the management of hazardous fuels. As the Federal agencies, including BLM, implement fire management activities (both wildfire suppression and treatment activities to reduce wildfire fuels) on the ground, the frequency and location of effects to WHB populations and habitats increase across the landscape. WHBs may cross administrative boundaries onto other federal, state, or private lands. In the short-term (10-15 years), fire management activities in habitats proposed for intensive fuels reduction treatments (prescribe fire or mechanical, chemical, or biological treatments) would need to be coordinated among the Federal agencies to reduce the combined effects of lost habitat and forage on various Federally administered lands. The overall reduction in catastrophic wildfires on all Federal lands within Arizona would also reduce the chance for direct mortality or emergency gathers of WHBs.

4.8 Fish and Wildlife Resources

The purpose of this section is to identify and predict the likely outcomes for fish and wildlife species and their habitats associated with BLM fire management alternatives. Direct impacts to fish and wildlife resources from fire or fire management activities typically result from mortality or displacement of individuals, disturbance from reduced air or water quality from smoke and ash, and alteration of immediate post-fire or post-treatment environments through loss of or changes to key habitat components (*e.g.,* food availability or quality, cover from predators, thermal refugia, nesting/denning habitat, water availability and quality, travel corridors, etc.) (Smith 2000, Esque *et al.*, 2003). These direct impacts may affect wildlife populations or habitats for one or two seasons or for several years after a fire or a vegetation treatment activity, depending on the ability of the fish or wildlife species to recolonize burned or altered habitats, the severity of the habitat alteration, and the recovery time of the habitat. Indirect impacts to fish and wildlife resources from fire or fire management activities typically result from influences of post-fire succession, recovery, or rehabilitation of the habitat. These impacts tend to be long-term, depending on the severity of the habitat alteration, and can change species assemblages (relative abundances or species composition), species behaviors, or overall population trends, benefiting some species and negatively affecting others (Smith 2000, Esque *et al*. 2003).

The direct and indirect effects of wildfire (either catastrophic or managed) on fish and wildlife resources vary tremendously, depending on a variety of factors such as animal species complex; size, shape, and habitat types of a fire-created mosaic; fire intensity, duration, and frequency; fire location, shape, and extent; season of burn; rate and composition of vegetation recovery; change in vegetation structure; type of soils; topography and microsites; and mobility of fish or wildlife species (i.e., ability to leave a site during a fire or recolonize a site after a fire). In addition, many of these same factors influence the effect of fire management activities (*e.g*., prescribed fire; mechanical, chemical, or biological treatments of fuel loads; and fire suppression) on fish and wildlife populations and habitat. Any effects to vegetation communities would affect the resident wildlife and fish populations. Vegetation characteristics such as structure, production, and composition provide or influence habitat suitability, such as seasonal cover and food availability, for particular predator and prey species.

The following discussion presents a comparison of the scope and type of effects that would be expected under the No-Action Alternative and the Proposed Action Alternative. Because of the variety of fish and wildlife species occupying BLM-administered lands in Arizona, and their diverse habitat requirements, it is difficult to generalize the effects of wildfire and fire management activities on these resources. Direct, indirect, and cumulative impacts are discussed generally, and the actual range of impacts would vary among fish and wildlife species and habitat types.

4.8.1 No-Action Alternative

Under the No-Action Alternative, BLM would continue to suppress all wildfires, regardless of ignition source or vegetation type, in accordance with current LUP and Fire Management Plan direction. Continuing fire management under this alternative would result in no new impacts to fish and wildlife species and their habitats. Both direct and indirect effects to fish and wildlife resources from implementing the No-Action Alternative would be widespread, intense, and long-term or permanent.

The primary effects to fish and wildlife resources under the No-Action Alternative would be continuing, periodic loss or alteration of habitats from large, catastrophic fires, or conversely, from aggressive fire suppression techniques that alter the natural density, structure, and composition of fire-adapted or fire-threatened habitats. The number of fires and acres burned as well as the intensity and severity of the burns is likely to increase. In Arizona, many fire-adapted vegetation communities (*e.g.,* Great Basin Desertscrub, grassland, semi-desert grassland, chapparal, woodland, and forested habitats) on BLM-administered lands are overgrown with dense shrubs and young trees because they have been subjected to a regime of aggressive fire suppression and fire exclusion. The Sonoran Desertscrub and Mojave Desertscrub communities, which are not fire-adapted, are susceptible to and have been altered by unnatural fires because of the introduction and proliferation of non-native annual plants. The severe alteration of riparian areas from a variety of causes has left this important habitat type threatened by fire. The conditions of these vegetation communities affect the abundance and diversity of wildlife species directly by creating unfavorable habitat conditions for some species, while favoring others. In addition, these fire-adapted and fire-

threatened vegetation communities are at high risk of unnatural, high-intensity wildfire events.

Under the No-Action Alternative, the likelihood of catastrophic stand-replacing or stand-altering fires in these habitats would increase, with the direct effects on fish and wildlife resources varying among species. Depending on species mobility, wildlife would experience impacts from mortality or displacement, harassment during fire suppression activities, and reduction of air quality from smoke and ash. For those species that cannot flee a burn, the most exposed habitat sites are dry, exposed slopes, hollow logs with a lot of exposed wood, burrows less than 5 inches deep, lower branches of trees and shrubs, and poorly insulated underground or ground-nesting areas (Lawrence 1966 as cited by Peek 1986). While small animals (mammals, reptiles and amphibians) are most at risk for mortality because of their limited mobility, occasionally large mammals are killed by severe fast-moving wildfires, typically from smoke inhalation (Smith 2000). Catastrophic fires would also continue large-scale or intense alterations of habitat components for many fish and wildlife species, which would favor some species and displace others. Immediate post-fire conditions raise light penetration and temperatures on and immediately above and below soil surfaces and can reduce soil moisture, affecting ground-dwelling species (Lyon *et al*. 1978). Burning of cover and destruction of trees, shrubs, and forage modify habitat structure (Lyon *et al.* 1978, Smith 2000, Esque *et al.* 2003). The loss of small ground cover and charring of larger branches and logs would affect small animals and birds that use these components for nesting, thermal or escape cover, or foraging. Early vigorous vegetation growth immediately after a fire would alter feeding and nesting behaviors of some species (Lyon *et al*. 1978, Smith 2000, Cunningham *et al*. 2001). Alterations in terrestrial or riparian habitats would also affect water quality and habitat components for fish and other aquatic species. Catastrophic wildfires leave the surrounding soil and accumulated ash vulnerable to erosion and remove shading streamside vegetation, increasing sedimentation and water temperature.

Catastrophic wildfires or long-term fire suppression strategies, as implemented under the No-Action Alternative, would also continue the indirect effects of changes in population dynamics (abundance, density, and reproduction) and long-term alteration of vegetation components over a large land area. Although fires may cause direct mortality to animals, the indirect effects to populations of different species are highly variable. Large-scale losses of small animals may be off-set by high reproductive potential and ability to recolonize burned sites. Animals with lower reproductive potential would experience longer term recovery from loss. Loss of a few large mammals from fire may not affect the overall population (Smith 2000). Overall, indirect effects to populations highly depend on the species and the severity of the habitat change caused by the fire.

Catastrophic fires frequently create more homogeneous habitats within and among vegetation communities, thereby reducing or changing the assemblage of species occupying these altered habitats. While a shift in vegetation composition and succession is natural after a catastrophic fire, an extensive conversion with no interspersed patches of the former habitat type is not characteristic of the fire regime in most vegetation communities of Arizona. These unnaturally large or severe habitat changes present several problems for resident wildlife and fish populations that could extend many years into the future.

For example, fires burning a ponderosa pine/mixed-conifer forest in which years of fire exclusion have caused high fuel loads can kill virtually all of the trees and understory vegetation with extensive crown runs. Because of this severe habitat alteration and the slow recovery of forested habitats (large, old-growth trees), the burned area may spend decades as a site dominated by a shrub community interspersed with numerous large snags. While these new conditions may favor bird species inhabiting dense shrub communities or woodpecker species requiring snags, forest-dependent species would be excluded from the site. High-intensity fires create large numbers of snags that are normally of high value to many wildlife species (Smith 2000). Their value, however, is reduced for some species if the area of snags is too large and surrounding vegetation does not afford other necessities, such as food and cover. Also, high-intensity fires result in fewer snags several years later as the fire created snags fall and growth of the single-age class forest to a snag-producing age takes many decades (Smith 2000).

In lower elevation vegetation communities, such as Sonoran or Mojave Desert Scrub, increases in invasive grass and shrub species have altered these habitats to a point where fires now carry in habitats that are intolerant of fire or fire suppression activities. Wildfire can cause rapid and profound changes in desertscrub habitats, both in the short-term and long-term, because many desert plants are not well adapted to large disturbances by fire (Esque *et al*. 2003). For example, the large cactus species that provide critical nesting and foraging habitat for many wildlife species, may take decades or centuries to recover from fire. In addition, fires now burn hotter and

farther, reducing the natural mosaic pattern (patchy distribution of plants and open space) typical to desertscrub communities (Esque *et al*. 2003). Although aggressive suppression of wildfires would continue under the No-Action Alternative, catastrophic fires in these fire-intolerant habitats would lead to mortality, displacement, loss of food and shelter, and changes in animal communities for fish and wildlife species not historically impacted by fires or fire suppression activities. While extirpation (100% mortality) of entire populations in burned areas is unlikely, direct mortality of wildlife (particularly small animals) in desert fires is fairly common, although highly variable (Esque *et al*. 2003).

Under the No-Action Alternative, it is unlikely that resource objectives to return altered wildlife and fish habitats to a more desired condition (*e.g*., increases in native vegetation communities, return of vegetative structure to more natural conditions, reduction of invasive weed species, increases in habitat heterogeneity) could be achieved, as severity and suppression of catastrophic wildfires would continue to dominate wildfire management activities. Indirect effects to wildlife and fish habitats and populations from long-term changes in vegetation composition and structure caused by aggressive fire suppression and catastrophic wildfires would continue in all vegetation communities under the No-Action Alternative.

Fire suppression activities also have direct and indirect effects on fish and wildlife species and their habitats. Water that is removed from small bodies of water for helicopter bucket drops may affect aquatic organisms by depleting their habitat, removing individuals (particularly in small isolated populations), or spreading disease or non-native, predatory species (*e.g.*, bullfrogs) among different water sources. Conversely, water drops can, in some circumstances, be used instead of hand lines ("wet-lining") to control fire movement. This tactic would result in less impact to soil, forest litter, and vegetation than hand line construction and, therefore, would have less impact on wildlife, both in intensity and duration. Some terrestrial wildlife could be struck by water or retardant drops, resulting in injury or chemical contamination or be disturbed by the low-flying aircraft. Construction of helispots often results in the felling of trees and snags, which are important habitat components. In addition, helicopter traffic would likely disturb wildlife, such as nesting raptors. Hand line construction would remove and disturb soil and forest litter, possibly affecting animals such as small mammals, amphibians, invertebrates, and ground-nesting birds. The presence of hand line crews in remote locations could cause direct disturbance of some wildlife species and introduce unnatural food sources. Removal of forest litter and vegetation can also lead to soil erosion and increased siltation in adjacent lakes and streams. Any fire suppression action that requires the felling of snags to protect human safety and the integrity of the fire line would potentially affect wildlife by reducing the availability of snags to species such as woodpeckers, squirrels, or some bat species. Felling would likely kill some animals. The number of snags lost would vary, depending upon factors such as the type and age of tree stand, its history of fire and/or disease or insect infestation, and the intensity of the fire. Direct and indirect impacts from most of these fire suppression techniques would be short-term, temporary, and localized, particularly if sensitive habitats (*e.g.,* raptor nests, riparian areas) are avoided to the extent possible and rehabilitation of fire lines are completed. However, suppression actions in the arid desertscrub communities may be longer term or more intense, since these vegetation communities have much longer recovery periods from activities that highly disturb the soils or vegetation, thereby having a longer term effect on the wildlife species that inhabit them.

Direct effects from mortality or displacement of individuals and from loss of key habitat components and indirect effects from long-term changes in habitat composition or quality would be more widespread and intense in a greater variety of habitat types under the No-Action Alternative compared to the Proposed Action. Because of the higher risk of wildfire and its potential greater severity, impacts from fire suppression activities are also more likely to occur under the No-Action Alternative than under the Proposed Action.

4.8.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

Under the Proposed Action, BLM-administered lands would be assigned to one of four fire management categories, based on the wildfire threat to human life and property and the historic fire regime (fire return interval or fire-adaptability of vegetation). Under the Proposed Action, BLM would use a variety of treatments and fire management activities to reduce hazardous wildland fire fuels in the WUI and to improve rangeland and forest health in fire-adapted and fire-threatened vegetation communities. The degree of fire suppression would vary among the four categories. In general, BLM would implement the proposed new fire management actions and treatments in habitats that are fire-adapted or fire-

threatened; habitats that are not fire-adapted or have long fire-return intervals would continue to be managed with aggressive fire suppression. In addition, as the Desired Future Conditions are achieved in various locations, BLM may change the fire management category for a particular site. For purposes of this analysis, it is assumed that implementation of the Proposed Action, including achieving wildfire and other resource objectives through a variety of fire management activities, would be accomplished over the next 15-20 years.

The various treatments and fire management actions under the Proposed Action would have a variety of direct effects on the resident fish and wildlife species. Adverse impacts would be lessened for some species if the timing of the prescribed fire or vegetation treatment avoids critical seasons, such as reproductive periods, when the loss of cover would be critical to wildlife or fish; for example, the bird nesting season or prior to wet weather conditions that may increase runoff into aquatic habitats.

Fish and wildlife species occupying particular sites would experience repeated direct effects from the various treatments, particularly prescribed fire and mechanical or manual treatments, since these fire management activities would need to be repeated periodically to maintain reduced fuel loads or retain particular resource objectives or conditions. However, as the Desired Future Conditions of a site are achieved, the intensity and scope of these effects would be reduced, as habitat conditions are restored or fuel loads are minimized and stabilized.

Catastrophic Wildfires. Under the Proposed Action, the risk and scope of the direct effects to fish and wildlife from catastrophic wildfires would be substantially reduced compared to the No-Action Alternative. The adaptive management of wildfires in Categories C and D, and the treatment activities to reduce wildfire fuel loads in all four categories, would reduce the severity and size of catastrophic wildfires in a variety of habitats and vegetation communities. Fewer and less severe catastrophic wildfires would reduce mortality and loss of key habitat components, and retain a greater percentage of unburned habitats for refuge and recolonization of burned habitats by various wildlife species and for reduced sedimentation into aquatic habitats.

Managed Wildfire. Under the Proposed Action, the average annual number of acres burned by adaptively managing wildfires would increase in sites designated as Categories C and D, while sites in Categories A and B would continue to emphasize suppression of naturally-ignited fires. Conditions for wildland fires would vary among years, with little burning occurring in some years, and much burning occurring in others.

Wildlife and fish species occupying the fire-adapted communities (and their associated waterways) on BLM-administered lands in Arizona would be most directly affected by managing naturally-ignited fires under the Proposed Action. Because natural ignitions are somewhat random events, areas burned would not necessarily be those of highest management priority. Also, some areas would likely burn at higher than natural intensities due to current levels of fuel accumulation, even when prescriptions were designed to minimize these effects. As a result, consumption of large woody debris (which provides habitat diversity) and removal of shrub cover would be greater than typically found within the natural range of variation for an area, while creation of habitat mosaics would be less than typical. Loss or alteration of these habitat components would directly affect species that favor dense habitat types; for example, shrews, brown creepers, or tiger salamanders in forested habitats, or bird species that prefer heavy shrub cover in chaparral habitats. Wildlife species would experience direct mortality or displacement from these managed wildfires, particularly in years of extensive burning or higher-intensity burns before fuel loads are reduced. In addition, fish species occupying waterways within these habitat types could be subjected to the direct effects of increased sedimentation and water temperatures from removal of upland vegetation. As with catastrophic fires, the duration, intensity, and scope of these direct effects to wildlife and fish depends on the species and the characteristics of the fire. In years of high wildland fire activity, large areas of habitat would likely be affected, changing their suitability for species favored under the altered habitat conditions created by a history of fire suppression. Some species occupying burn sites would show an initial decline in populations immediately following a fire, but would recover quickly with early successional recovery of the habitat or recolonization of the burned site (Smith 2000, Cunningham *et al*. 2001). Other species would exhibit long-term changes in populations or community assemblages if key habitat components are slow to recover or are targeted for permanent change in structure or composition by BLM fire management or resource objectives.

Direct effects to fish and wildlife resources from managed wildfires would be greater under the Proposed Action, compared to the No-Action Alternative, since more areas would be allowed to burn rather than be aggressively suppressed.

However, these direct effects under the Proposed Action would still be less than the direct effects to fish and wildlife habitat and populations from the higher risk of catastrophic fires that would continue under the No-Action Alternative.

Because fire suppression would continue as a primary fire management activity in non-fire adapted habitats, fish and wildlife species occupying these habitats would not experience direct impacts from adaptively managed wildfires.

Prescribed Fire. The use of prescribed fire would provide the potential for focused work to restore wildlife habitats and reduce the threat of catastrophic fire in many vegetation communities. Areas furthest from the natural fire regime, with identified threats to wildlife populations and habitats, could be targeted for treatment. Prescribed fires would be planned to occur under conditions that maximize achievement of resource objectives, including restoration of wildlife and fish habitat, and minimize fire-related impacts to sensitive wildlife resources (*e.g.,* nesting raptors or priority big game species).

Under the Proposed Action, prescribed fire would selectively be used in sites designated as Categories C and D, where conditions are suitable for using fire as a management tool. Killing vertebrates by prescribed burning is rare (Lyon *et al.* 1978). However, high levels of fuel loading in some sites would cause some prescribed fires to burn at higher than natural intensities, even when fire prescriptions were designed to minimize these effects. Conditions for prescribed fires would also vary among years, with little burning occurring in some years, and much burning occurring in others. As a result, direct effects to fish and wildlife resources from prescribed fires under these more intense conditions would be similar to those described for management of naturally-ignited fires. In addition, escaped prescribed burns could accidentally destroy riparian habitats and impact aquatic resources, causing losses of wildlife and fish through exposure, total loss of habitat, and through increased sedimentation of aquatic habitat from unchecked overland flow and destabilized stream channels.

Burning outside the typical fire season would minimize the direct effects of mortality, harassment, and displacement of some wildlife and fish species by avoiding critical nesting or breeding seasons or reducing the intensity of the fire and subsequent loss of key habitat components. However, some species that are adapted to the natural timing of fires may experience greater effects if they are unable to escape the burn or, if displaced, find adequate habitat resources (*e.g.,* food, shelter) during colder or wetter times of the year (Smith 2000, Esque *et al.* 2003).

In addition to reducing wildfire fuel loads and restoring vegetation communities, BLM would use prescribed fires to improve habitat components for big game and other wildlife species. Prescribed fires would change forage quality and quantity, intersperse new feeding areas with areas providing cover, and/or rejuvenate decadent browse plants for some priority wildlife species. For example, an important factor in the degree of use of burned juniper habitats by deer and elk is the interspersion of burned habitats, which provide food, and unburned sites, which provide thermal and hiding cover (Smith 2000).

If prescribed fire is used in fire-threatened, but non-fire adapted communities, such as Sonoran and Mojave Desertscrub, the effects to resident wildlife species would be highly variable, and management of the fire (including determining if or when to implement prescribed fire, as well as managing the prescribed fire itself) would be essential in ascertaining the direct effects to these populations. In these arid environments, use of plants that provide thermal cover, nurse-plants for plant re-establishment, and plants that provide cover from predators would all be directly affected by prescribed fire, thereby affecting the wildlife species that use them (Esque *et al*. 2003).

Fire Suppression Actions. Maintaining control of managed wildland fires and prescribed fires would involve fire suppression actions such as hand line construction, snag removal, and water drops. As described under the No-Action Alternative, some direct effects to fish and wildlife resources would occur from these wildfire management actions because of the increased use of managed wildfire and prescribed fire under the Proposed Action compared to the No-Action Alternative. However, such efforts are necessary and likely to be less intense than they would be during fire suppression activities associated with the current policy to aggressively suppress all wildfires or with suppression of catastrophic wildfires.

Manual Vegetation Treatment. Manual vegetation treatments involve the use of hand-operated power tools and hand tools to cut, clear, or prune herbaceous and woody plant species to reduce wildland fire fuel loads. This method is labor intensive, but can be extremely species selective and can be used in areas of sensitive fish or wildlife habitats, such as riparian habitats. This method would be used on sites designated as Categories A, B, or C, where fire (prescribed or naturally ignited) is undesirable or where significant constraints prevent widespread use

of fire as a management tool. These sites comprise a range of vegetation communities or habitat types, and include areas where there may be wildlife concerns, yet it is deemed beneficial to remove trees, shrubs, or other fuel loading vegetation. Manual vegetation treatments cause less ground disturbance and generally remove fewer amounts of vegetation than is associated with other treatment methods (prescribed fire or mechanical treatments). Thus, direct impacts to wildlife species, such as mortality, displacement, or loss of key habitat components, from this treatment method would be minimal and short-term for most species. This method would also minimize direct effects to fish species, since retention of more vegetation would reduce the likelihood of decreased bank stability, increased sedimentation, and increased water temperatures.

Mechanical Vegetation Treatment. Heavy equipment would be used where critical fuel conditions demand immediate, efficient action, and where natural resources can acceptably withstand the impacts associated with this method. This method would be used on sites designated as Categories A, B, or C, and include a range of vegetation communities, primarily habitats with dense shrub or woody components. Feller-bunchers, and other tracked or wheeled vehicles in these habitat types would create ground disturbance that would directly affect ground-dwelling animals, including salamanders, reptiles, and small mammals that occupy forest litter or low-growing shrubs. Adjacent habitats would remain unaffected, allowing recolonization. The noise of heavy machinery would cause some short-term disturbance of wildlife in treatment sites, and in adjacent areas.

Biological Vegetation Treatment. Biological methods of vegetation treatment employ living organisms to selectively suppress, inhibit, or control herbaceous and woody vegetation. Insects, pathogens, and grazing by cattle, sheep, or goats would be used as biological control methods to reduce fuel loads on sites designated as Categories A, B, or C. This method is extremely selective in controlling a target plant species; however, only a few plant species can be controlled in this manner. Typically biological control methods would not eradicate the target plant species, but merely reduce the target plant densities to more tolerable levels. Direct impacts on fish and wildlife species would be short-term and minimal, since direct mortality is unlikely, changes to habitat components would be gradual and targeted, and sufficient habitat would be retained for displacement and recolonization.

Chemical Vegetation Treatment. Chemical herbicides would be applied to reduce fuel loads in sites designated as Categories A, B, and C, including a variety of habitat types. Chemicals would be applied aerially with helicopters or fixed-wing aircraft, or on the ground using vehicles or manual application devices. Herbicide applications would be scheduled and designed to minimize potential effects to non-target plants, as well as fish and wildlife species. The chemical drops could inadvertently strike some terrestrial animals or aquatic habitats, resulting in injury or chemical contamination to wildlife and fish. The low-flying aircraft could also disturb some wildlife. Direct impacts to fish and wildlife species would be short-term, localized, and minimal, since direct mortality is unlikely, sufficient habitat would be retained for displacement and recolonization by wildlife species, and most aquatic habitats would be buffered from the chemical application.

Under the Proposed Action, the combination of adaptively managing wildfires, and reducing fuel loads or restoring historic fire regimes through prescribed fire, and mechanical, chemical, and biological vegetation treatment methods, would indirectly affect wildlife habitat and populations in the long-term by restoring wildlife habitats and reducing the threat of catastrophic fires in a variety of habitats managed by BLM in Arizona. Managed wildfires or treatments would increase species diversity and ecosystem resiliency by restoring habitat heterogeneity and lost or degraded habitats for indigenous species.

Managed wildland fire and prescribed fire would be valuable tools in restoring natural, fire-influenced wildlife habitat. In more arid habitats, the indirect effects from using prescribed fire to reduce non-native plant species would need to be carefully balanced with the direct effects of the fire itself (Esque 2003). Applying a diversity of treatment types both within particular vegetation communities and among the variety of BLM-managed lands, as proposed in this alternative, would provide for a range of variability in habitat types, including density and composition of vegetation, structural components, and course woody debris. Using the variety of proposed fire management actions to restore riparian or desertscrub habitats, and continuing aggressive fire suppression tactics, would improve vegetation composition and structure and reduce the amount of habitat lost or degraded by wildfires in these non-fire adapted habitats.

These long-term changes in vegetation would affect the species composition of wildlife occupying

habitats on public lands in Arizona. For example, in the few BLM-administered forested habitats, fire management activities under the Proposed Action that create a more open forested environment (i.e., less understory vegetation) and remove down wood or snags would alter important habitat components for wildlife species that depend upon this type of dense, habitat complexity, such as salamanders, lizards, small mammals, and ground-nesting birds. The overall conditions achieved, however, would benefit a larger number of species by restoring a forest structure that is within the range of natural variability for this fire-influenced vegetation community, with gaps and edge communities interspersed among the forest habitat. In juniper sites, complete type conversion to grassland using fire management activities would reduce wildlife diversity; however, creating a mosaic of successional stages and habitat composition, structure, and complexity with managed wildfire, prescribed burning, or mechanical treatments would favor a diversity of rodent and bird species, as well as providing restored browse species interspersed with cover sites for deer, elk, and other game species (Smith 2000). Old growth juniper stands may offer unique and valuable wildlife habitats, adding to the variety within juniper stands. Adaptively managing wildfire and using a variety of site-specific treatments would allow BLM to increase, restore, or maintain habitat and species diversity in the long-term by retaining old-growth juniper communities as islands and edge communities to the treated areas. In the arid desertscrub communities, using various treatments to reduce non-native grasses, such as red brome and buffelgrass, would reduce the occurrence of unnaturally severe wildfires that currently threatens the biotic diversity in these habitats (Esque *et al.* 2003).

Using a variety of fire management techniques that vary in their intensity and length of time for application and effectiveness would also assist in maintaining a range of variability of habitats. Methods that are less intensive (e.g., manual treatments), highly specific (e.g., chemical or biological treatments) or take a long time for effective reduction in fuel loading (biological treatments) may delay achievement of target habitat conditions in some areas, and limit the amount of vegetation removed. Such management would have different effects on wildlife. On one hand, delay in achieving target conditions would allow altered habitat conditions to continue and extend the threat of high-intensity fire in those areas. On the other, retention of more vegetation in treatment areas would favor species that prefer denser habitats. Conversely, treatment methods that provide quicker, more intensive, or widespread changes, such as managed wildfire, prescribed fire, or mechanical removal of hazardous fuels, may result in a more rapid return of habitat types to a more natural condition, with a corresponding more rapid, long-term return of the wildlife community to historic species composition. With all treatment types, reducing the risk of catastrophic wildfires would allow wildlife species and communities to move among and adapt to the altering habitat conditions accomplished by the fire treatment methods. Using a full range of fuel-reduction techniques would allow flexibility in achieving habitat restoration goals while minimizing adverse impacts to fish and wildlife species.

The National Fire Plan applies to the U.S. Forest Service, National Park Service, U.S. Fish and Wildlife Service, and Bureau of Indian Affairs, all of which manage federal land in Arizona. These agencies are also mandated to take the necessary measures to reduce the occurrence of catastrophic wildfire through the management of hazardous fuels. As the Federal agencies, including BLM, implement fire management activities (both wildfire suppression and treatment activities to reduce wildfire fuels) on the ground, the frequency and location of effects to fish and wildlife populations and habitats increase across the landscape. Because high-mobility wildlife populations do not recognize administrative boundaries, many species use or move through habitats on a variety of federal, state, and private lands. In the short-term (10-15 years), fire management activities in habitats proposed for intensive fuels reduction treatments (prescribe fire or mechanical, chemical, or biological treatments) would need to be coordinated among the Federal agencies, in cooperation with the state wildlife agency, to reduce the combined effects of mortality or displacement of species or altering large acreages of habitats on various Federally administered lands. Maintaining a mosaic of habitats across the landscape and across administrative boundaries would minimize any cumulative effects to fish and wildlife resources. In the long-term (>20 years), the overall improvement in structure, composition, and productivity in vegetation communities on all Federally administered lands within Arizona would improve the habitat quality and quantity (food, shelter, water, nesting/denning sites, etc.) and habitat variability for fish and wildlife species across the landscape. The overall reduction in catastrophic wildfires on all Federal lands within Arizona would also reduce the chance for large-scale direct losses of fish and wildlife populations and habitat within the state, increasing the chances for populations of some species to stabilize, and increasing ecosystem resiliency against other types of habitat disturbance

(*e.g.*, human population expansion and associated infrastructure development on private lands, particularly those adjoining BLM-administered or other federal lands).

4.9 Special Status Plant and Wildlife Species

The purpose of this section is to identify and predict the likely outcomes for special status species and critical habitats associated with BLM fire management alternatives. The following discussion presents a comparison of the scope and type of effects that would be expected under the No-Action Alternative and the Proposed Action Alternative. Direct, indirect, and cumulative impacts are discussed generally, and the actual range of impacts would vary among the special status species and habitat types.

4.9.1 Effects of the No-Action Alternative on Special Status Species

Under the No-Action Alternative, BLM would continue to suppress all wildfires, regardless of ignition source or vegetation type, in accordance with current LUP and Fire Management Plan direction. Continuing fire management under this alternative would result in no new impacts special status species and their habitats. Effects to special status wildlife, fish, and plant species from the No-Action Alternative would be similar to those described for Vegetation Resources (**Section 4.4**) and Fish and Wildlife Resources (**Section 4.8**).

Some special status species would benefit from continued aggressive fire suppression activities that minimize loss of individuals, populations, or critical habitats, particularly in habitats that are fire-threatened but not fire-adapted (e.g., desertscrub or riparian habitats). Conversely, fire suppression activities can also affect special status species through mortality, disturbance, or displacement; and removal, damage, or alteration of key habitat components. Currently, fire suppression operations that occur on BLM-administered lands in or near sites occupied by Federally protected species, or designated or proposed critical habitat, require emergency consultation or conference to comply with Section 7 of the Endangered Species Act, as amended. The need for Emergency Consultations would continue under the No-Action Alternative.

The long-term alterations in habitats and increased risk of catastrophic fires under the No-Action Alternative would also increase the risk to species' viability from large-scale losses of populations or habitat. This risk is particularly high for the small and/or disjunct populations or ranges of many special status species, which are more vulnerable to catastrophic events. Both direct and indirect effects to special status species from implementing the No-Action Alternative would be widespread, intense, and long-term or permanent compared to the Proposed Action Alternative.

4.9.2 Effects of the Proposed Action on Special Status Species

The Proposed Action would utilize adaptively managed wildfire, prescribed fire, mechanical, biological, and chemical fuels treatments, combined with fire suppression and restoration or rehabilitation, in order to achieve desired future conditions. Site-specific assessments would determine if and when fire suppression operations or the proposed fire management activities would be appropriate management tools in sites or habitats occupied by or adjacent to special status species.

This section conveys general, potential effects to special status species from implementing fire suppression and the proposed fire management activities under the proposed action. The duration, intensity, and scope of effects to special status species and their critical habitats depend on the species and the characteristics of the activity. General and species-specific Conservation Measures (Appendix D) would be implemented to the extent possible to minimize effects to the species.

A Biological Evaluation (BE) was prepared that contains detailed analyses of all federally listed (endangered or threatened), proposed, and candidate species (herein referred to as "Federally protected" species), and designated or proposed critical habitat that may be affected by the proposed action. It includes analyses of all direct, indirect, and cumulative effects, as well as any interrelated and interdependent actions, of the Proposed Action, including fire suppression operations. The comprehensive analysis of fire suppression activities in the BE, combined with implementing Conservation Measures, would result in greater consistency statewide for managing Federally protected species, as well as minimizing or eliminating the need for future emergency consultations when fire suppression activities occur within the range of these species or their critical habitats.

The species-specific analyses within the BE for this project are incorporated here by reference. **Table 4.7**

provides a summary of the effects determination for each Federally protected species within the action area. Based on discussions and analyses during informal consultation, determinations were made that the proposed action would have no effect on 22 species within the action area of the project (see Appendix B of the BE).

Table 4.7 – Summary of effects for protected species in Arizona considered in the Biological Evaluation for the proposed action.

Common Name	Federal Status[a]	ESA Species Determinations[b]	ESA Critical Habitat Determinations
Amphibians			
Chiricahua leopard frog	FT	LAA	n/a
Birds			
Cactus ferruginous pygmy-owl	FE, PCH	LAA	NAM
California brown pelican	FE	NLAA	n/a
California condor	FE, 10(j)[c]	NJ	n/a
Masked bobwhite	FE	NLAA	n/a
Northern aplomado falcon	FE	NLAA	n/a
Southwestern willow flycatcher	FE	LAA	n/a
Yuma clapper rail	FE	LAA	n/a
Bald eagle	FT	LAA	n/a
Mexican spotted owl	FT, CH	LAA	NLAA
Mountain plover	PT	NJ	n/a
Yellow-billed cuckoo	FC	NJ	n/a
Fish			
Bonytail chub	FE, CH	NLAA	NLAA
Desert pupfish	FE, CH	LAA	NE
Gila topminnow	FE	LAA	n/a
Razorback sucker	FE, CH	LAA	LAA
Virgin River chub	FE, CH	LAA	LAA
Woundfin	FE, CH 10(j)[d]	LAA, NJ	LAA
Yaqui chub	FE, CH	LAA	NLAA
Yaqui topminnow	FE	LAA	n/a
Beautiful shiner	FT, CH	NLAA	NLAA
Little Colorado spinedace	FT, CH	LAA	LAA
Loach minnow	FT, CH	LAA	LAA
Spikedace	FT, CH	LAA	LAA
Yaqui catfish	FT, CH	NLAA	NLAA
Gila chub	PE, PCH	NJ	AM
Flowering Plants			
Arizona cliffrose	FE	LAA	n/a
Brady pincushion cactus	FE	LAA	n/a
Canelo Hills ladies'-tresses	FE	LAA	n/a
Holmgren (Paradox) milk vetch	FE	LAA	n/a
Huachuca water umbel	FE, CH	LAA	NLAA
Kearney's blue-star	FE	LAA	n/a

Common Name	Federal Status[a]	ESA Species Determinations[b]	ESA Critical Habitat Determinations
Nichol Turk's head cactus	FE	LAA	n/a
Peebles Navajo cactus	FE	LAA	n/a
Pima pineapple cactus	FE	LAA	n/a
Cochise pincushion cactus	FT	LAA	n/a
Jones cycladenia	FT	LAA	n/a
Siler pincushion cactus	FT	LAA	n/a
Acuna cactus	FC	LAA	n/a
Fickeisen plains cactus	FC	LAA	n/a
Mammals			
Black-footed ferret	FE, 10(j)	NJ	n/a
Hualapai Mexican vole	FE	LAA	n/a
Jaguar	FE	NLAA	n/a
Lesser long-nosed bat	FE	NLAA	n/a
Mexican gray wolf	FE, 10(j)	NJ	n/a
Ocelot	FE	NLAA	n/a
Black-tailed prairie dog	FC	NJ	n/a
Reptiles			
Desert tortoise, Mohave population	FT, CH	LAA	LAA
New Mexico ridgenose rattlesnake	FT	LAA	n/a

[a] Federal status designations are Endangered (FE), Threatened (FT), Proposed Endangered (PE), Proposed Threatened (PT), Designated Critical Habitat (CH), Proposed Critical Habitat (PCH).
[b] Determinations for Federally listed (endangered or threatened) species and designated critical habitat are: 1) no effect (NE); 2) may affect, is not likely to adversely affect (NLAA); 3) may affect, is likely to adversely affect (LAA). Determinations for proposed or candidate species, or experimental/non-essential populations (10(j) species) are 1) would jeopardize (J); or 2) would not jeopardize (NJ). Determinations for proposed critical habitats are 1) would adversely modify (AM); or 2) would not adversely modify (NAM).
[c] Species listed as "10(j)" are designated experimental/non-essential populations under Section 10(j) of the Endangered Species Act, as amended. This designation provides greater management flexibility.
[d] In addition to the full protection of this listed species under the ESA, experimental/non-essential (10(j)) populations have been designated, but not yet re-introduced, into designated sites outside its historic range.

Direct Impacts of Proposed Action:

Terrestrial Wildlife Species

Direct effects to special status wildlife species from fire suppression and the proposed fire management activities would be similar to those described in the Environmental Consequences for Fish and Wildlife Resources (**Section 4.8**). These effects would include, but are not limited to:

- Mortality or injury of adults, young, or eggs from smoke inhalation or crushing by vehicles or equipments used during fire management operations.
- Disturbance or displacement of individuals from smoke, noise, and other human activities associated with the operations, affecting foraging, roosting, or reproductive behavior.
- Nest abandonment or mortality of young, resulting in the loss of one year's recruitment.
- Loss of key habitat components for nesting, foraging, roosting, or cover.

Fish and Other Aquatic Species

Direct effects to special status fish and aquatic species from fire suppression and the proposed fire management activities would be similar to those described in the Environmental Consequences for Fish and Wildlife Resources (**Section 4.8**). These effects would include, but are not limited to:

- Mortality of adults, young, or larvae from using occupied water sources during fire suppression or proposed fire management activities.

- Loss of habitat (water quantity) from dewatering during low flow periods.
- Spread of disease or non-native, predatory species (*e.g.*, bullfrogs) among different water sources.
- Chemical contamination of individuals or aquatic habitats from fire retardant drops or herbicide applications.
- Damage or loss of riparian or upland vegetation, resulting in:
    - decreased channel stability and alteration of channel morphology;
    - increased erosion and sediment and ash levels within and adjacent to the stream channel;
    - increased water temperature;
    - degraded water quality (nutrient, temperature, and sediment levels);
    - reduced riparian and instream habitat cover and woody debris necessary for properly functioning riparian areas and aquatic habitat;
    - altered water velocities and substrate composition; and
    - decreased and altered composition and abundance of aquatic and terrestrial food sources.

Plant Species

Direct effects to special status plant species would include, but are not limited to:

- Heat stress from prescribed fire or suppressed wildfire
- Mortality from prescribed fire or suppressed wildfire
- Crushing from use of vehicles during treatments
- Crushing from human foot traffic in treatment areas
- Accidental crushing during mechanical treatments/piling of slash
- Accidental removal during mechanical treatments
- Stress or mortality to non-target organism during chemical treatments
- Stress or mortality to non-target organism during biological treatments
- Damage to the seedbank due to fire severity or mechanical disruption

Indirect Impacts of Proposed Action:

In addition to the indirect effects described below, some special status species may experience interdependent effects from aggressive fire suppression actions that minimize the amount of riparian or upland vegetation lost from catastrophic wildfires, as well as interrelated effects from post-treatment restoration activities that quickly restore riparian and upland vegetation. These effects would be similar to the No-Action Alternative.

Implementation of the proposed fire management actions to reduce fuel loads and improve forest and range conditions over the long-term would also reduce the risk of catastrophic wildfires on riparian and upland habitats that are within or adjacent to special status species and their critical habitats. This would reduce the large-scale loss of populations, and occupied, suitable, or critical habitat, resulting from these severe wildfires.

Terrestrial Wildlife Species

Indirect effects to special status wildlife species from fire suppression and the proposed fire management activities would be similar to those described in the Environmental Consequences for Fish and Wildlife Resources (**Section 4.8**). These effects would include, but are not limited to:

- Increased risk of predation from removal of cover.
- Changes in food quality and quantity or foraging habitats.
- Long-term changes in habitat quality or quantity for nesting, roosting, foraging, or cover, affecting the ability of a species to continue occupying a site, or facilitating the return of a species to its historic range.

Fish and Aquatic Species

Indirect effects to special status fish and aquatic species and their habitat typically include degradation and alteration of hydrologic processes, functions, and watershed conditions, such as decreased water quality and quantity, increased soil erosion and compaction, alteration of overland and stream sedimentation rates. These effects would result in similar impacts as the direct effects, but are typically later in time or long-term, creating chronic adverse effects to fish species and their habitats.

In the Southwest, the fire season starts around March and ends around the end of June. This fire season is immediately followed by the summer monsoon season of July to August. Consequently, watersheds occupied by or upstream from special status fish species or critical habitats in which fire suppression activities have impacted riparian or terrestrial

vegetation would potentially be followed by localized heavy precipitation and runoff into streams.

Plant Species

Indirect effects to special status plant species would include, but are not limited to:

- Soil erosion within the area of its habitat following prescribed fire or suppressed wildfire
- Change in vegetative composition in the habitat from management of fire, or mechanical/biological/chemical treatments
- Change in vegetative structure in the habitat from management of fire, or mechanical/biological/chemical treatments
- Increase in invasive species in the habitat which may outcompete this species due to management of fire, or mechanical/biological/chemical treatments

Cumulative Impacts of the Proposed Action:

Cumulative impacts to special status wildlife, fish, and plant species include the past, present, and reasonably foreseeable future actions or management strategies that, when taken together, result in the gradual loss of individuals or populations of special status species. Cumulative effects to special status species under the proposed action would include, but are not limited to, the following broad types of impacts:

- Changes in land use pattern that adversely affect a species' habitat.
- Encroachment of human development into a species habitat or potential habitat.
- Fire management actions by some, or all, of the following groups, on lands adjoining or upstream of BLM-administered lands:
    - United States Forest Service
    - National Park Service
    - U.S. Fish and Wildlife Service
    - Bureau of Reclamation
    - Tribal Governments
    - State of Arizona
    - County Governments in Arizona
    - Local Governments in Arizona

As fire management and habitat restoration activities are implemented on Federal lands in Arizona over the long-term, a range of variability in upland and riparian habitats would be retained across the state, variously affecting special status species and their critical habitat. In the short-term (10-15 years), fuels reduction or restoration activities in riparian and upland habitats would need to be coordinated among the Federal agencies to minimize any cumulative effects on special status species and critical habitats. In the long-term (>20 years), the overall improvement in terrestrial and riparian habitats and reduction in catastrophic wildfires on Federally administered lands within Arizona would reduce the chance for large-scale direct losses of the various special status species and critical habitats within the state.

Declines in the abundance or range of many special status species have been attributed to various human activities on Federal, state, and private lands, such as human population expansion and associated infrastructure development; construction and operation of dams along major waterways; recreation, including off-road vehicle activity; and grazing. Many of these activities are expected to continue within the range of the various special status wildlife, fish, and plant species. Improvements in riparian and upslope habitats within or adjacent to sites occupied by special status species or critical habitats on Federal lands in Arizona through fire management or other restoration activities, as well as aggressive fire suppression when necessary, would increase the chances for populations of some special status species to stabilize, particularly in areas with checker-boarded land ownership patterns. These improvements would potentially increase the resiliency of some watersheds and populations of special status species against other human-caused threats to a species' viability.

4.9.3 Federal Species of Concern (Conservation Agreement Species and Management Plan Species)

In addition to the general effects described above, and the species-specific analyses for Federally protected species found in the BE, the proposed action may affect four species that are considered Federal Species of Concern and are managed under Conservation Agreements or Management Plans that the BLM participates in. The following analysis discusses the potential effects to these species.

Flat-tailed Horned Lizard (*Phrynosoma mcallii*) Federal Species of Concern (Conservation Agreement)

The current range of the flat-tailed horned lizard includes the extreme southwestern corner of Arizona, much of which has been converted to agriculture or is managed by the Department of Defense (Marine Corps). Only a few very small parcels of public

lands occur within the species' range. The Lower Colorado River Valley subdivision of Sonoran Desertscrub habitat, where the flat-tailed horned lizard currently resides, contains minimal vegetation. In Arizona, the lizard typically inhabits sandy flats where galleta grass is abundant. The proposed fire management actions would not be implemented in habitat within the species' range, as no vegetation would need to be thinned or removed to reduce hazardous fuel loads or restore range conditions. The sparse vegetation on BLM-administered lands within the horned lizard's range would not carry large, fast-moving, or severe catastrophic fires requiring aggressive suppression activities. Thus, the flat-tailed horned lizard would not experience any direct, indirect, or cumulative effects from implementing the proposed action on BLM-administered lands within the species' range.

Kaibab (Paradine) Pincushion Cactus (Pediocactus paradinei) Federal Species of Concern (Conservation Agreement)

Kaibab pincushion cactus has a narrow range, but it spans four separate ecosystems, including Great Basin Desert Scrub, Great Basin Piñon-Juniper Woodland, Great Basin Plains and Grassland, and Montane Conifer Forest. The historic fire regime in this area varied from low severity with a frequency of 0-35 years, to stand replacement with a frequency of 35-100+ years. The current condition mapping shows a classification of 2 to 3, with class 3 being a regime that significantly departs from the historic model. The proposed action would offer a variety of options for fuel treatments in these diverse ecosystem types. The grassland type would likely be treated with prescribed fire. The piñon-juniper woodland could be treated with prescribed fire and mechanical thinning. The montane forest could be treated with both prescribed fire and mechanical thinning. The desert scrub would likely feature only mechanical thinning. The potential effects to the Kaibab pincushion cactus from this suite of treatments would include the possibility of fire stress, fire-induced mortality, and seedbank damage from prescribed fire, and accidental crushing/removal during mechanical treatment. Other possible treatments include wildfire suppression and management of natural wildfire starts for habitat benefit. Effects would potentially include fire stress, fire-induced mortality, and seedbank damage. The effects to this species from the proposed action would typically be short-term or localized.

In order to prevent adverse effects from prescribed fire, mechanical treatments, wildfire suppression, and management of natural wildfire starts for benefit in Kaibab pincushion cactus habitat, the following Conservation Measures are suggested:

- Survey probable treatment areas for this species prior to initiation of treatment
- Establish a site-specific and appropriate buffer around individual plants of this species
- Do not lop, scatter, or pile slash onto this species
- Keep vehicles on existing roads in treatment areas
- Prevent excessive foot traffic through Kaibab pincushion cactus habitat
- Reseed only with native species appropriate to these ecosystem types and monitor for invasive weed infestations

Virgin Spinedace (*Lepidomeda mollinspinis mollinspinis*) Federal Species of Concern (Conservation Agreement)

In Arizona, the tributaries of the Virgin River that support this species occur primarily on state and private lands, with some BLM-administered lands. However, most upland habitat surrounding these occupied reaches is managed by BLM. The Mojave desertscrub upland and riparian habitats within the range of the Virgin River chub are moderately to severely altered from their historic fire regime, putting them at higher risk for wildfires that are larger or more severe, intense, or frequent, and causing greater changes to or loss of the vegetation. This, in turn, puts the downstream or downslope aquatic habitats of the Virgin spinedace at greater risk to direct and indirect effects from wildfires, and, potentially, fire suppression and the proposed fire management activities. For most fire suppression efforts in the vicinity of Beaver Dam Wash, the Virgin River is the largest source of available water. The Virgin spinedace would experience direct and indirect effects from fire suppression actions and the proposed fire management actions on BLM-administered lands within its range as described in the general effects for fishes. Implementation of the Conservation Measures (Appendix D) for riparian and aquatic habitats and for the species would minimize any effects to the species from these actions.

Conversely, Virgin spinedace would experience the beneficial interdependent effects from aggressive fire suppression actions within the riparian and upslope terrestrial habitats surrounding the Virgin River tributaries, which would minimize the amount of vegetation lost from catastrophic wildfires. They would also experience beneficial interrelated effects from post-fire rehabilitation and restoration activities,

which would restore riparian and terrestrial vegetation, and protect the fish's habitat.

This fish species has been affected by other activities on federal, state, and private lands that have cumulatively contributed to its decline. Many of these activities, such as urbanization, water diversion and impoundment, degradation of water quality, and competition with introduced species (fish and crayfish), are expected to continue within the range of the species. Implementing a combination of the proposed fire management actions to reduce fuel loads and improve riparian and upslope terrestrial habitats, as possible, combined with aggressive fire suppression as necessary, would reduce the risk of catastrophic wildfires and provide long-term improvements in the Virgin River watershed (including its tributaries occupied by the Virgin spinedace). These improvements would potentially increase the resiliency of the watershed, as well as Virgin spinedace populations, against large-scale losses from wildfires as well as other activities that threaten the species viability. These actions would assist in implementing the Conservation Management Agreement to reduce threats to the species.

Desert tortoise, Sonoran population [*Gopherus agassizii (xerobates)*] Federal Species of Concern (Management Plan)

Increases in invasive grass and shrub species have altered the Sonoran desertscrub habitats used by the Sonoran population of desert tortoises to a point where fires now carry in these habitats that are generally intolerant of fire or fire suppression activities. Wildfire can cause rapid and profound changes in desertscrub habitats, both in the short-term and long-term, because many desert plants are not well adapted to large disturbances by fire (Esque *et al*. 2003). In addition, fires now burn hotter and farther in desertscrub habitats, reducing the natural mosaic pattern (patchy distribution of plants and open space) typical to these communities (Esque *et al*. 2003).

In some instances, the proposed fire management actions would be used to restore and maintain habitats, to reduce accumulated hazardous fuels, and to reduce the chance of catastrophic fire. Site-specific assessments would determine if and when these activities are appropriate in habitats occupied by desert tortoises. In general, aggressive fire suppression would continue to be the primary fire management activity within habitats for the Sonoran population of desert tortoises. The primary direct and indirect effects to these tortoises would be from fire suppression, adaptively managed wildfire, prescribed fire, and mechanical vegetation treatments. Biological and chemical treatments would not likely be used in desert tortoise habitat and, thus, would not affect the Sonoran population of tortoises.

Direct effects to tortoises from these activities would result from mortality or injury and degradation or loss of key habitat components (e.g., cover, forage). Tortoises could be disturbed, injured, or killed and burrows and clutches of eggs could be destroyed during construction of fire lines (using handlines or heavy equipment), campsites, and staging areas; off-road driving; or adaptively managed wildfires, prescribed fires, or backfires lit during fire suppression operations. These effects to tortoises would be more intense during periods of surface activity for tortoises (spring and early summer and post-monsoon in the fall), or when they are occupying shallow cover sites. With the exception of water, which is considered benign or beneficial for tortoises and tortoise habitat, the effects on desert tortoises of retardants used during fire suppression are unknown. Indirect effects to desert tortoises from the proposed action would result from increases in predation through attraction of predators to human-activity sites and increased exposure from loss of cover; disturbance, injury, mortality, or collection by OHV recreationists using roads and fires lines created during treatment or suppression activities; reduced forage quantity and quality; or long-term alterations, degradation, or loss of suitable habitat, particularly from fire suppression (backfires), adaptively managed wildfire, and prescribed fire.

Using the variety of proposed fire management actions, as appropriate and possible, to restore desertscrub habitats, and continuing aggressive fire suppression tactics, as necessary, would, in the long-term, improve vegetation composition and structure and reduce the amount of habitat lost or degraded by wildfires. The risk of catastrophic wildfires would be reduced, by reducing fuel loads, including non-native annual grasses that carry fires in desertscrub habitats. Because use of these fire management techniques would be selective and be implemented in phases, a range of variability of tortoise habitat would be retained. The short-term direct loss of habitat in treated locations would be balanced with retention of current habitat conditions in nearby untreated sites, providing refuge and recolonization sources for desert tortoises. These long-term effects would potentially minimize any cumulative effects to the Sonoran population of desert tortoise from activities on Federal, state, and private lands, particularly where land ownership patterns are checker-boarded.

To minimize effects to the Sonoran population of desert tortoise from fire suppression and the proposed fire management activities, similar Conservation Measures as for the Mojave population of the desert tortoise (Appendix C), including restrictions on timing and locations of activities, should be implemented as appropriate.

4.10 Cultural and Paleontological Resources

4.10.1 No-Action Alternative

4.10.1.1 Prehistoric/Historic Resources

Under the No-Action Alternative, wildland fire would continue to occur, with direct impacts resulting from fire intensity/duration, and from mechanical and/or chemical suppression activities. Direct impacts would include damage or destruction of prehistoric and historic sites and associated artifacts; destruction of organic materials such as bone, plant and animal fibers, and timber elements of historic structures; and destruction or chemical changes in materials used for dating archeological sites. A discussion of potential impacts relating to fire intensity and duration is provided in the discussion of direct impacts of prescribed burning provided below. Uncontrolled wildland fire would be expected to have more severe effects to prehistoric and historic resources than those of prescribed burns, where the intensity and duration of the fire is more controlled. Impacts from mechanical fire suppression activities would include potential destruction of artifacts and other materials, and the disturbance of site context and loss of scientific value of individual sites. Chemicals used for suppression of active wildland fire would not affect prehistoric/historic resources.

4.10.1.2 Places of Traditional Cultural Importance

No places of traditional cultural importance were identified by Indian tribes during preparation of the LUP Amendment EA. See the discussion below for an assessment of potential impacts to such areas from prescribed burns (typically of lesser intensity/duration than wildland fire) and the use of mechanical equipment, such as would be utilized in wildland fire suppression.

4.10.1.3 Paleontological Resources

Under the No-Action Alternative, exposed fossil resources would continue to be subject to scorching or cracking by wildland fire, however, the impact of such fires on such resources has not been quantified. Organic materials (Pleistocene and later), such as the remains of bison and other large land mammals, would potentially be damaged or destroyed by wildland fire and mechanical suppression activities.

4.10.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

No direct impacts from the amendment of existing LUPs would occur. However, implementation of the amendment would lead to direct impacts from fire management activities. Potential direct impacts resulting from the anticipated treatments/processes would be as described below.

Impacts Relating to Prescribed Burning

Prehistoric Resources

Prehistoric resources potentially affected by prescribed burns may be inorganic (lithics, ceramics, etc.) or organic, and certain such resources may be of significance in the potential dating of archeological sites. It must be acknowledged that, in addition to the factors discussed below, the probability or evidence of previous wildland fire events is a significant factor in determining whether prescribed burning (or other treatment methods, for that matter) could cause a direct effect to prehistoric resources which may have been damaged by fire in the past.

Inorganic Resources. The effects of fire on archeological resources are dependent upon the fire's intensity, its duration, and the depth of heat penetration into the soil. For archeological purposes, the severity of a fire is measured by its intensity (low, moderate, or heavy). Fires would burn with increased duration and temperature in proportion to the accumulation of dry fuel on the ground. The depth of heat penetration is dependent upon factors such as soil type, moisture, and coarseness, and the abundance of dry fuel. For inorganic resources such as lithic tools, stone implements, and ceramics, fire may be expected to cause cracking and spalling, darkening of surfaces, and changes in chemical composition (for ceramic paints). Effects of fire would expect to be mitigated somewhat depending upon the depth of the resources below the surface. When fires remain below 500º C and occur within half an hour (as is typical for prescribed burns), little

damage to artifacts and resources even at shallow depths is likely to occur (Pyne, 1996).

For some rock art sites, such as localities with pictographs or petroglyphs, effects may range from darkening of the surface from soot, obscuring the image, to destruction caused by cracking or breakdown of the chemical properties of the medium. Intaglios and rock alignments may be less affected due to the typically sparse vegetation in localities where they are present.

Organic Resources. As expected, organic resources such as bone, hair, animal and vegetable fibers, and wood are extremely susceptible to fire, particularly in an arid climate. Even relatively low intensity/duration fires would likely destroy such materials occurring on the surface. The greater the depth of organic materials, the less likely they would be affected by fire.

Dating Resources. Radiocarbon dating of organic materials (such as charcoal or bone fragments) associated with archeological sites is a common procedure. The destruction of such material would adversely effect the ability to date such sites. In addition, exposure to high temperatures could cause chemical changes in organic material which would compromise the ability to accurately radiocarbon date such material.

Obsidian is a siliceous mineral found in numerous volcanic area around the world, often collected and traded in prehistoric times and used for artifact production (Delmonte 1985). Obsidian develops hydrated surface layers when exposed to moisture. Hydration rates vary, but 200 to 400 years per micron thickness of the hydrated layer is typical, and these rates are used to date the time elapsed from the exposure of the surface by lithic flaking techniques.

Studies on the effects of prescribed burning on obsidian hydration bands have been conducted. As expected, temperature and duration of exposure are primary factors in the potential for damage to obsidian hydration bands. Laboratory analysis indicates that exposure to temperatures below 100º C (212º F) for less than 24 hours does not change hydration bands. It was noted that soil temperature during prescribed burns remain below 100º as long as moisture remains in the soil (Solomon, 2002). The precise relevance of laboratory experiments to actual prescribed burn situations has not been established.

Historic Resources

Structures built of combustible materials, or containing combustible materials (such as timber elements of adobe structures) are highly susceptible to fire. Other materials, such as machinery utilized in historic mining operations, are less susceptible, depending upon the intensity and duration of the fire. Resources such as historic trails or mine shafts are unlikely to be directly affected by fire, although associated structures could be damaged or destroyed. Organic artifacts associated with historic properties and occurring on the ground surface could be destroyed, while such artifacts beneath the ground surface would likely be protected, depending upon the degree of soil heating.

Impacts Relating to Mechanical Treatment

Prehistoric Resources

Mechanical treatment involves the use of wheeled and crawler-type tractors with attached implements for clearance of undesired plants and fuel accumulations. Direct effects would be damage or destruction of archeological resources occurring on the surface and within the root zones of cleared vegetation, resulting in loss of site integrity and associated scientific values.

Historic Resources

Direct effects of mechanical treatment would be damage or destruction of historic resources including structural remains and associated materials occurring on the surface and within the root zones of cleared vegetation, resulting in loss of site integrity and associated scientific values.

Impacts Relating to Chemical Treatment

Prehistoric Resources

Intense ground disturbance would not result from chemical treatment options. Little information exists regarding the effect of chemical treatment methods on prehistoric (particularly organic) resources. Chemical treatments with an organic component might have the potential to affect ^{14}C material used for site dating, however, such effects would be expected to diminish for subsurface material. Potential contamination of Carbon-14 samples would not preclude dating of archeological sites by other, contextual, methods (i.e. lithics, ceramics).

Historic Resources

Some long term fire retardants containing ammonium phosphate or ammonium sulfate can leave a white residue and attract water, potentially causing damage to wood, which may be present in historic structures. Discoloration of metallic surfaces may also occur. Foam detergents and surfactants (wetting agents), as well as water enhancers, used as fire retardants may also damage wood by causing swelling and contraction.

Impacts Relating to Biological Treatment

Prehistoric Resources

The use of insects and pathogens in biological treatment would have no direct effect to prehistoric archeological resources. In areas where surface artifacts or features occur, the use of grazing animals could cause damage as the animals' hooves could displace or damage such resources.

Historic Resources

No direct effect to historic structures would be anticipated as a result of biological treatment options. Fragile surface artifacts, such as glass or ceramics, associated with historic sites would be subject to damage by the hooves of grazing animals, although this would not appreciably affect the scientific/historic value of the site.

Impacts Relating to Manual Treatment

Prehistoric Resources

Direct effects relating to use of manual clearing of vegetation would be disturbance of archeological resources by displacing surface and subsurface material by pulling, grubbing or digging plant root systems. Such activity would compromise the scientific value of archeological sites to the degree that such activities disturbed the surrounding soil matrix. Effects would be related to the destruction or damage of artifacts by breaking or chipping, and to the scientific value of site context by shifting artifacts and disturbing the chronological sequence of deposition. Not to be neglected is the potential for illegal collection of artifacts by workers. It is noted that in vegetated areas, some level of disturbance to archeological resources would have been expected to occur, due to dislocation by plant growth and animal activity (such as burrowing).

Historic Resources

Direct effects to historic structures and structural remains by manual clearing activities would be minimal, and in some instances could be beneficial, as the growth of vegetation within or adjacent to structural remains tends to accelerate the disintegration process. Effects of manual clearing to artifacts associated with historic sites would be similar to those for prehistoric resources, as noted above. With the exception of areas such as trash pits, artifacts associated with historic resources in Arizona tend to occur at the surface or higher subsurface levels.

No indirect impacts to prehistoric or historic resources from the treatment methods described in Section 2.4 have been identified.

Changes in Federal wildland fire management policy are applicable to other Federal agencies in Arizona and would typically have similar potential impacts to cultural resources as described in this EA. These agencies would also be subject to the Section 106 requirements referenced in the next section. The treatment methods described in Section 2.4 would be more aggressively pursued in areas where the risk of wildfire is considered to be higher than average, or where such wildfire is considered undesirable. The potential impacts from these methods would typically be less severe than those from an unmanaged wildfire event. It is therefore considered that - all other past, present, and foreseeable future land management actions in the state of Arizona being equal - the cumulative impacts from the proposed LUP Amendment, would be less severe to cultural resources than the No-Action Alternative.

All treatment actions with the potential to effect cultural resources are subject to the requirements of Section 106 of the National Historic Preservation Act, 36 CFR 800, and the BLM 8100 Manual series. Because many archeological sites may have been exposed to wildland fire in the past, sites identified during field surveys prior to prescribed burning or mechanical treatments will be evaluated to determine whether the sites have been damaged from wildland fire events, and to evaluate the potential effects of proposed treatment methods on such sites. As such, ground disturbing treatment methods described under the Proposed Action would require site-specific cultural resources evaluation, including examination of records of known sites and an intensive cultural resources inventory (Class III). Mitigation, usually in the form of avoidance, would be necessary if a determination was made that NRHP-eligible properties would be impacted by a proposed action.

Should undocumented cultural resources be identified in the course of ground-disturbing treatment, the treatment action would immediately cease until appropriate notification procedures have been accomplished and a decision for proper handling of the resource has been made. Wooden structures and metal surfaces will be avoided when applying chemical retardants, except when such features are in danger of imminent exposure to wildland fire.

4.10.3 Places of Traditional Cultural Importance

Areas used traditionally for hunting would be expected to revegetate following a fire event, although this may occur slowly. The loss of game animals and their habitat until such time as revegetation occurred would also be expected. For localities where food and/or medicinal plants are gathered, effects would be dependent upon the amount of time such vegetation would require in order to reestablish. The threat of invasive species occupying areas associated with traditionally important vegetation is also an issue of concern. In areas where invasive species currently predominate, the potential for culturally important native plant species to reestablish following prescribed burns or other treatments may be enhanced.

No places of traditional cultural importance were identified by Indian tribes during preparation of the LUP Amendment EA. However, needs for protecting, and accommodating access to, any such places identified by tribes following approval of the LUP Amendment would be considered prior to implementing individual fire management actions.

4.10.4 Paleontological Resources

Direct, Indirect, and Cumulative Impacts:

Organic materials (typically those associated with extinct Pleistocene land mammals) exposed at or immediately below the ground surface could be damaged or destroyed by manual, mechanical, or prescribed burning treatments. Older, fossilized, remains could potentially be damaged by mechanical vegetation treatments. Although some scorching could be associated with prescribed burns, no serious damage to paleontological resources would be expected. In the event that paleontological resources were discovered in the course of a ground-disturbing treatment, such treatment would cease pending evaluation by a qualified paleontologist.

No indirect impacts to paleontological resources associated with the Proposed Action have been identified. Changes in Federal wildland fire management policy are applicable to other Federal agencies in Arizona. Such policy changes would typically have similar potential impacts to paleontological resources as described in this EA. Such impacts would be mitigated by avoidance of scientifically significant fossil resources.

4.11 Visual Resources

Scenic quality and landscape aesthetics is managed on BLM lands to meet the objectives of four VRM classes established in LUPs, as discussed in Section 3.3.3. The discussion below evaluates how scenic characteristics might change under the No-Action and Proposed Action Alternatives. The level or degree of impact is assessed primarily on basis of VRM classes. Visual impacts are caused by changes in the landscape induced through either 'natural' processes or management practices and human activities. The acceptable degree of change or contrast is established by the VRM class designations. In terms of impact from wildland fire, the consequences of visual impacts are greatest for VRM classes I and II, lesser for VRM class III, and least for VRM class IV.

4.11.1 No-Action Alternative

Current RMP direction for management of risks and hazards of wildland fire is suppression of unplanned ignitions. The LUPs do not provide direction for management strategies to reduce the risk of wildland fire or rehabilitate areas after wildland fire has passed through an area. Therefore, trends of increased risk and hazard due to the accumulation of fuels are likely to continue for all VRM classes. Wildland fires are expected to increase in occurrence and severity, potentially burning and charring visually sensitive areas.

4.11.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

The Proposed Action would provide vegetation treatment strategies that are consistent with managing scenic quality on BLM lands. Non-fire fuels treatments could be implemented to reduce hazardous fuels with little apparent change to the character or scenic quality of the treatment area. Vegetation treatments using prescribed fire could result in more visual impact on the landscape than non-fire vegetation treatments. With prescribed burning, the treatment areas would be blackened, woody debris would be charred, and, at least during treatment,

smoke would reduce visibility. As such, the goal of allowing fire to resume a more natural ecological role across the landscape in consideration of VRM objectives constitutes a conflict between ecological sustainability and scenic aesthetic. VRM classes I and II are at the same time the most 'natural' and the most sensitive to visual impact. In areas where fire would naturally occur, VRM class restrictions on the acceptable degree of change may preclude the re-introduction of fire into the ecosystem.

Relatively more aggressive fuels treatment would be allowed in VRM class III and IV areas and could indirectly lead to the protection of the more sensitive VRM class I and II areas where fuels treatments may be more restricted. Unplanned ignitions would be less likely to occur and spread in VRM class III and IV areas due to fuels reduction, thereby reducing overall threat to VRM class I and II areas across the landscape. Fuel hazards may not be reduced in some VRM class I and II areas due to management restrictions based on scenic quality objectives. The threat of unplanned ignitions and spread of wildfire within these areas could remain high. Smoke from prescribed fire in less sensitive VRM class III and IV areas could disperse across VRM class I and II areas and affect visual quality over the duration of the fuels or vegetation treatment.

Site-specific fire management activities are expected to cumulatively contribute to better ecosystem conditions and the reduction of fire hazards across the landscape. This could lead to broad-scale sustained ecosystems and scenic aesthetics. Activities on BLM lands, including recreational use, carry the risk of unplanned ignitions and consequential wildfire that could impact scenic quality. Other management activities on BLM lands or adjacent lands not related to fire management could equally impact scenic quality. The proposed adaptive management approach to managing fire and fuels on BLM lands could, in part, reduce cumulative impacts through area designation of fire management categories, establishment of long-term goals, and emergency stabilization and rehabilitation of areas burned by wildfire.

4.12 Special Designation Areas

4.12.1 No-Action Alternative

The No-Action Alternative would result in continuation of existing fire management direction. No new impacts to special designation areas were identified under the No-Action Alternative.

4.12.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

Potential direct impacts in special designation areas would be limited to plant mortality and removal of organic matter in defined areas of treatment. These direct impacts may include a combination of any of the following items: prescribed fire, mechanical construction of fuel breaks, thinning of forested stands (removal of ladder fuels and immature trees), chipping, piling and burning of excess fuels (live plant biomass plus decaying materials), application of chemical treatments, and addition of biological controls for overall vegetative health.

It is intended that no treatments that fall within the Proposed Action would intentionally result in loss of an area's building facilities (e.g., park visitor centers), roads, utilities, trails, and other manmade infrastructure. Adaptive management for wildland fire would also avoid direct impact to all known cultural resources and sensitive species habitat (e.g., federally listed species). The Proposed Action would rigorously seek to avoid alteration of the natural character of special designation areas, by maintaining the native vegetation of an area and by limiting construction of temporary roads and trails. Depending upon the type of special designation area being managed under the Proposed Action, the use of mechanized tools would be carefully limited to the minimum necessary to accomplish the tasks at hand.

Indirect impacts from the Proposed Action may include mortality to resident animal life in defined areas of treatment. Smoke from prescribed fires may indirectly impact a variety of resources including wildlife and visitors to these special designation areas. Indirect impact from smoke should be temporary. The Proposed Action may initially increase runoff and erosion, thus indirectly impacting riparian ecosystems and water quality downstream of treatment areas. Finally, the uses of prescribed fire, chemical treatment, and biological treatment have some potential to affect areas outside of those targeted by the adaptive management action. This realistic impact would be indirect and could be very serious in special designation areas, as evidenced by the indirect impacts suffered at Los Alamos National Laboratory during a prescribed fire treatment.

Western ecosystems have been previously altered by the No-Action Alternative, where full suppression is widely believed to have resulted in overcrowded and unhealthy forests and shrublands. In these settings, dense fuel loads exist and catastrophic wildland fires are a result. The Proposed Action would seek to

change this paradigm, through adaptive management treatments. Thus, a cumulative impact in special designation areas may include the alteration of vegetative composition and structure at the landscape level, over time. This may lead to alteration of ecological function of these areas as fire returns to its historic role. This type of cumulative impact is beneficial over the long term.

Mitigation measures for animal mortality should include inventorying treatment areas prior to initiation of proposed adaptive management. Following inventory, animals may be herded, trapped and relocated, or otherwise safeguarded from likely impacts. Mitigation for smoke would involve setting prescribed fires under proper atmospheric conditions and with a focus on limiting or eliminating smoke from certain critical areas, such as around human habitation and critical wildlife habitat areas. Prescribed fires would be properly planned and executed to avoid the likelihood that they may spread into non-target portions of special designation areas.

4.13 Land Uses

4.13.1 No-Action Alternative

Under the No-Action Alternative there would be no new impacts to livestock grazing, recreation, forestry, and mineral resources. All wildfires— regardless of ignition source—would be suppressed in accordance with current LUPs and fire management plans. Recent large fires have burned with such intensity that many land-uses of Arizona rangelands have been altered. The primary impacts from continuing the current fire management practices are periodic disruption to livestock grazing, recreation, forestry, and mineral resources which would have varying impacts depending on the land use. Disruptions to livestock grazing are multi-year because BLM policy requires at least a two-year period of rest to allow desirable forage to re-establish after fire. Recreation disruptions in magnitude and duration would vary depending of the fire location, severity, aesthetics, vegetation recovery, and damage to facilities. Forestry resources in the burned area may be totally or partially lost and decades would be required for trees to again become of product value. Impacts to mineral resources may include disruption of transportation corridors and utilities, and damage to facilities. The WUI would probably increase in the future as people continue to build houses near forests and rangelands.

4.13.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

Under the Proposed Action, it is assumed that the Desired Future Conditions would be achieved over the next several years. As the Desired Future Conditions are achieved there would be fewer adverse affects to land uses from catastrophic wildfire losses. The need for emergency post-fire rehabilitation to control soil erosion, the loss of wildlife habitat and livestock grazing land, and other adverse effects would lessen. The continuing trend of building houses in the WUI is expected but with the reduction of hazardous fuels, the risk of wildfire loss should lessen.

Livestock grazing with regards to fire and land-use management can be beneficial or detrimental. Livestock grazing may be able to reduce the buildup of hazardous fuels through consumption and trampling. Grazing may be an acceptable approach to reduce hazardous fuels in the WUI where other methods may not be suitable. Goat grazing is beneficial in reducing woody plant material. Cattle and sheep grazing can reduce herbaceous fuel build-up. Livestock trampling may be able to break-up fuels into smaller sizes which enhances the rate of decomposition. On the other hand, improper grazing can lead to increased wildfire hazard through the established of annual weeds such as cheatgrass, buffelgrass, and red brome. The overgrazing of desirable forage reduces plant vigor and encourages annual weeds to become established. Many times the weedy plants acerbate the hazard of wildfire because upon senesces they become highly flammable fuels. Recurring fire would eventually result in the loss of desirable livestock forage with an increase in weed dominance.

Outdoor recreationists and tourists can contribute to wildfire risk on BLM rangelands. Human caused fire is on the increase supposedly in response to increased number of visitors to BLM land and carelessness (**Table 4.5**). However, human caused fire is not new on BLM land. Native Americans purposely used fire for warfare and hunting. Even today, BLM range managers use prescribed fire to reduce the build-up of hazard fuels and to improve rangelands for livestock grazing and wildlife habitat. These fires, however, are carefully planned and controlled under specified conditions defined in a burn plan. Nevertheless, the difference today is that many human-caused wildfires are accidental and caused by neglect. Such things as not completing extinguishing a camp fire, sparks from OHV, chain saw, or railroad car, improper disposal of barbeque

ashes, fireworks, and numerous other ways can cause wildfires. Public outreach programs and interpretive signs are ways to educate the public on ways to reduce human-caused fires. BLM seeks to reduce the risk of human-caused fire by strictly enforcing appropriate fire-related activities during certain seasons of the year and in certain localities.

Forest lands include ponderosa pine forests, pinyon and juniper woodlands, and mixed conifer and deciduous woodlands. Forest products are limited to firewood and fence posts. The Proposed Action would reduce hazard fuels in these areas through prescribed fire, mechanical, biological, or chemical treatments would reduce the risk of catastrophic fire. Fires that do occur, whether prescribed of natural fire, would be managed to achieve resource goals. Improvements in rangeland and forest health would also improve forestry resources.

Mineral exploration and extraction activities are directly impacted by fire through disruption of surface resources such as transportation corridors, utility right-of-ways, and buildings. Exploration activities may need to be altered in burned areas to lessen the potential for soil erosion and allow vegetation time to recover. The Proposed Action would reduce the risk of fire to mineral resources by reducing the occurrence of catastrophic fire through hazardous fuel reductions and improvements in forest and rangeland health.

As the Desired Future Conditions are achieved, improvements in land use would occur. Over the long term, vegetation communities should return to their normal range of variability in plant composition, structure, and productivity resulting in improved plant health and vigor, and wildlife habitat. This in turn would improve livestock grazing, the quality of recreation, and forestry opportunities. Mineral resources would not be impacted by any indirect effects.

The National Fire Plan applies to the U.S, Forest Service, National Park Service, U.S. Fish and Wildlife Service, the Bureau of Indian Affairs, as well as the BLM. All of these agencies administer federal land in Arizona and have fire management responsibilities. These agencies are mandated to take the necessary measures to reduce the occurrence of catastrophic wildfire through the reduction of hazardous fuels including weeds and to improvement forest and rangeland health. As these agencies seek to return vegetation communities to their normal composition, structure, and productivity through reduction of hazardous fuels, there should be an overall improvement in forest and rangeland health and wildlife habitat throughout the state. The overall occurrence and acres burned from catastrophic wildfire should decrease and lessen the impact of catastrophic fire on livestock grazing, recreation, forestry, and mineral activities. State and local agencies and private land owners may become involved through partnerships with federal agencies.

4.14 Socio-Economic Conditions

The purpose of this section is to identify/predict the likely social and economic outcomes associated with BLM management alternatives, including impacts to public and firefighter health and safety. Direct, indirect, and cumulative impacts are discussed generally, and the actual range of impact would vary among individuals and businesses. The following discussion presents a useful comparison of the scope and type of effects that would be expected under the "no-action" alternative (continuation of current fire management practices) and the Preferred Alternative.

4.14.1 No-Action Alternative

Under the "No-Action" Alternative, there would be no new impacts to the socio-economic environment. Full fire suppression would continue under this alternative. As shown in **Table 4.5**, it is expected that more than 230 fires and 49,000 acres of BLM-administered lands would burn in Arizona each year due to wildfires. Over time wildfires would tend to grow larger in size, intensity, and severity due to unnatural fuel loading conditions. The primary impacts from continuing the current fire management practices are risks to public and firefighter safety during fire suppression activities, loss of income from destruction of resources (timber, pasture, businesses, etc.), fire suppression costs, watershed restoration costs, costs of health impacts (particularly from air or water quality effects), altered transportation patterns, altered sense of place, and impacts to subsistence activities. The movement of people into Wildland-Urban Interface (WUI) areas is expected to continue into the 21st century. Under the No-Action Alternative, protecting communities and private parcels from wildfire would become increasingly more difficult and expensive.

Since 1989, there have been at least nine deaths of firefighters in Arizona while suppressing large, catastrophic wildland fires (including two deaths in 2003). In 2003, the Aspen Fire burned 84,750 acres and destroyed 340 homes before it was contained; and in 2002 the Rodeo-Chediski fire burned 469,000 acres and destroyed 491 homes. Recent catastrophic

wildfires have burned with such intensity that the ecosystems have been drastically changed. Economic impacts arise both directly from fire damage and indirectly from changes in local economic activity, such as a drop in tourism. Both direct and indirect effects of wildfires have exacted a heavy economic toll on many communities. The consequences of recent catastrophic wildfires on Arizona's natural resources are as vast as they are varied. Wildland fires burned both public and private lands over a broad spectrum of rangeland and forested ecosystems, often encompassing entire watersheds critical to community water supplies. These burned lands are also susceptible establishment of undesirable noxious weeds. The cost to eradicate unwanted invasive species such as cheatgrass, although unquantified, is very large.

4.14.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

Under the Proposed Action, it is assumed that the new Desired Future Conditions would be achieved gradually, over 10 to 15 years or longer. As the Desired Future Conditions are achieved, and a more natural fire regime is established over time, there would be fewer economic losses from large, unplanned, catastrophic wildland fires.

The reduction of hazardous fuel loads would reduce the risk of a wildland fire reaching catastrophic levels and crossing boundaries onto private lands or public lands administered by other agencies. As a result, overall safety for the general public and potential fire hazard conditions facing fire personnel will be greatly improved. Over the long-term, the Proposed Action would enhance public and firefighter safety by reducing the number and extent of catastrophic wildfires, reduce the number of homes and other property destroyed by catastrophic wildfires, and reduce the need for seasonal firefighters and wildfire suppression equipment and support services. This change could affect the income of seasonal firefighters and companies that support wildland fire suppression (air tankers, equipment, logistics, etc.), since there would be fewer large wildland fires. This change would be long-term and permanent.

Direct impacts from increased use of prescribed fire, and chemical, mechanical and biological fuels treatment, would be primarily short-term and temporary (fuel reduction treatments would need to be repeated every few years). The Proposed Action would have higher annual treatment costs to the BLM. These higher treatment costs would result in new opportunities for contractor-provided treatment support services, partially off-setting lost revenue from reduced wildland fire suppression service contracts. During prescribed fires, direct impacts would include altered transportation patterns, altered sense of place, and impacts to subsistence activities. If over the long-term, the public perceives an improvement in wildland fire management, people that were dissuaded from moving into WUI areas due to hazards from catastrophic wildland fires might be more likely to move; thus, the Proposed Action might indirectly support increased movement into WUI areas. Wildfire suppression monies circulate through the region would be reduced, and replaced at a lower amount by monies from chemical, mechanical, biological treatments, or prescribed fire equipment and support services.

Changes in Federal wildland fire management policy also apply to the U.S. Forest Service, National Park Service, and Bureau of Indian Affairs in Arizona. BLM's reduced need for catastrophic wildland fire suppression support could combine with reduced needs for suppression support services by other Federal agencies. Wildfire suppression monies circulating through the region would also be reduced.

4.15 Environmental Justice

4.15.1 No-Action Alternative

Under the No-Action Alternative, there would be no new adverse or disproportionate impacts to minority or low income populations.

4.15.2 Proposed Action

Direct, Indirect, and Cumulative Impacts:

The Proposed Action is not expected to disproportionately affect any particular population. Environmental affects such as air quality would affect the area's population equally, without regard to ethnicity or income level.

No indirect impacts are expected.

No cumulative impacts are expected.